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13. ABSTRACT

This report contains description and program documentation of a conversational unit for univariate and multivariate analysis of data in regular or irregular two-way classification designs. The main part of this report is Chapter IV which, on the basis of detailed illustrations, describes the question-and-answer frames on a Graphics (IBM 2250) console. The user is assumed to be a "layman" in the sense that he need not be familiar with statistical analysis in computer programming techniques. He receives instructions for description of his data from the graphically displayed questions. He has a choice to make several plots of his data (for cells, rows, or columns of the design, each response variable vs. another response variable). In the univariate analysis he obtains detailed reports on means, adjusted means, and the analysis of variance tables, for each response variable. After data have been edited the user may perform a multivariate analysis and will obtain discriminant functions, union-intersection and likelihood-ration test statistics, and correlations. He may repeat this for various subsets of response variables. Thus, this unit includes and supersedes the unit described in THEMIS report No. 13 (April, 1971). Program documentation is presented in Chapter V. The listing of the FORTRAN programs is contained in the appendix.

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLL	WT	ROLE	WT	ROLE	WT
Statistics						
Analysis of Variance						
Multivariate Analysis						
Data Analysis						
Design of Experiments						
Discriminant Analysis						
Interactive Computation						
Conversational Computation						
Computer Graphics						

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AN INTERACTIVE MULTIVARIATE DATA ANALYSIS PROGRAM

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CHAPTER I

INTRODUCTION

The use of the computer in the statistical analysis of experimental data is usually available only to people, or teams, who have statistical and computational experience. In particular, the experimenter who collects the physical data can rarely do the analysis on the computer without help.

The ever-increasing use of terminals, both typewriter consoles and graphic display units, appears to become a promising link between the experimenter and the analysis of his data. Of course, these terminals need to be programmed by experts in computation and statistical analysis before they can serve the function of analyzing the experimenter's data. Too often, specialists in some field with a smattering knowledge of statistics and some elementary programming experience "write their own subroutines". There are literally thousands of "least squares" and "regression" programs embodied in terminal systems. In view of the utter simplicity of this problem, most would probably work all right, a few may be inefficient (especially where factorial designs are irregular and the inexperienced statistical layman would use a "general linear model" approach for their problem setting up, say, a 20 by 20 equation system where a statistician would obtain the same result from a 3 by 3 equation system), still others probably lack precision in any but the smallest studies.

Another problem in this universal practice of laymen writing their own ad hoc program, or using a poorly understood package, is that they apply inappropriate techniques. The more advanced tools of analysis which should be used on their data are forever inaccessible to them. Our approach to this problem has been to have experienced statisticians write conversational units addressed to the experimenter with supposedly incomplete knowledge of statistics and computation. On the basis of answers given to these questions, the computational program will perform the statistical analysis warranted by the data.

In the present thesis we deal with the general complex of "analysis of variance" in one-way and two-way (irregular) classification designs, involving either univariate or multivariate responses. There exists a variety of programs for this set of analysis of which most are for use in the batch mode. One major problem, however, especially in the multivariate pass (multivariate analysis of variance, discriminant analysis) is the disturbing influence of even very few faulty data, i.e., data which may have been transcribed incorrectly or contain keypunch errors, such as misplaced decimal points, or outliers or other types of mavericks. Hence, before any meaningful analysis can be made the investigator must be sure that he has good data.

Since it may be time-consuming to perform an initial analysis of variance, then in a new run to edit the data, and thereafter to perform more analyses, a conversational approach to the problem seems to be indicated. The conversational unit available to us is an IBM 2250 Graphics console which is connected with an IBM 360 Model 65 computer. The 2250 display unit has an alphameric keyboard and a program function

keyboard to serve as input devices, and a cathode-ray tube as an output device. Thus, a communication exists between the user and the computer.

This thesis presents a brief description of the classical approach of adjusted normal equations which is employed in the analysis of variance and its multivariate extension. The user is then presented with a description example of how the program can be used. Finally, the computer programs are documented.

Special notation which will be used:

μ incidicence matrix

n_{ij} cell size

$\underline{n}_{\cdot j}$ vector of column sizes

$\underline{n}_{i\cdot}$ vector of row sizes

n sample size

$\underline{R}$ vector of row totals

$\underline{c}$ vector of column totals

G grand total

$Dn_{i\cdot}$ diagonal matrix with elements of $\underline{n}_{i\cdot}$ in principle diagonal

See references [2] and [3] for further explanations.

CHAPTER II

DESCRIPTION OF THE CONVERSATIONAL UNIT

The user, at the console, is asked to supply some general information about his data (title, variable names, transformations, factor names, level codes, etc.). Second, he must enter his data either from the typewriter or by a special batch run if his data are voluminous.

On each response variable, a univariate analysis of variance is then performed (assuming, in any event, an irregular two-way classification model - see Section 3.1). In addition to the usual analysis of variance and the customary F statistics, the display contains a report of means in each cell, size (incidence) of each cell, standard deviations of observations within each cell, adjusted row means, adjusted column means, and various other quantities. Some hints are given in a special instructional display as to how the user should utilize these results in order to identify faulty data.

Next, the user is given an option to view selected graphical displays of his data (data in a cell, data in a row or column, all data; each response variable against each other response variable). This enables him to detect unusual behavior of some observations. He may then go back to a display of his original data, and make any changes which he desires on the basis of the study of tables of means and the graphs. He may then, if he chooses, perform another univariate pass for further inspection.

After thus editing his data, the user may now proceed to a multivariate analysis. He is asked, specifically, which variables he wishes to include in this, or any subsequent, multivariate pass [5]. This is an important aspect of our program in that, all too often, multivariate analyses are badly distorted by some variable which should not be included in the same study (e.g., when one response variable is a mathematical function of others; if it is linear, of course, the entire analysis would be false).

The output display of the multivariate pass contains the usual quantities of multivariate analysis, i.e., the Likelihood-Ratio test statistic for each effect, the Union-Intersection statistic ("canonical R^2 as goodness-of-fit"), the discriminant function, and most important, the correlation of each response variable versus the discriminant function [2]. In addition, the display contains correlation matrices between the selected response variables based on sums of squares and products for (a) error, (b) total, (c) rows plus error, (d) columns plus error.

After viewing the multivariate analysis displays the user may perform additional univariate and multivariate analyses; he may see his displays again and do additional editing. He may continue until he is satisfied that he has viewed his data from every conceivable angle.

In closing it is important to note that the CPU time needed for the analyses is quite short (a few seconds only even for the multivariate pass of extensive sets of data). Our console, as most other conversational terminals, operates in a time shared mode under a special monitor

[4]. Thus, the user has the ability to spend considerable time in front of the console, without requesting computer time any longer than he would have in batch mode. In fact, by employment of programs designed for speed [1] the computer time is of one or more orders of magnitude shorter than that required for other statistical packages.

A more detailed description of the flow of the analysis is presented in Chapter 4.

CHAPTER III

TOOLS FOR STATISTICAL ANALYSIS

In this chapter, we describe those subprograms which employ special statistical techniques of analysis. The other subprograms which deal with standard mathematical algorithms (inversion, eigenvectors, numerical integration) or data processing, are summarized in Chapter 5.

3.1 Program ANOT

Analysis of Irregular Two-Way Classification Designs

The model for an irregular two way design with interaction is

$$E(y_{ijk}) = \mu + \alpha_i + \beta_j + \delta_{ij}$$

where y_{ijk} is the k^{th} observation in the ij^{th} cell,

$i = 1,\ldots,r$

$j = 1,\ldots,c$

$k = 1,\ldots,n_{ij}$, n_{ij} is the number of observation in the ij^{th} cell. If $n_{ij} = 0$, the ij^{th} cell is empty. For convenience in arithmetic, let $r \leq c$.

Let the incidence matrix be as follows:

$$N = \begin{bmatrix} n_{11} & n_{12} & \cdots & n_{1c} & n_{1\cdot} \\ n_{21} & n_{22} & \cdots & n_{2c} & n_{2\cdot} \\ \vdots & & & & \\ n_{r1} & n_{r2} & \cdots & n_{rc} & n_{r\cdot} \\ n_{\cdot 1} & n_{\cdot 2} & \cdots & n_{\cdot c} & n \end{bmatrix}$$

If the incidence matrix is proportional, i.e. $n_{ij} = (n_{i.} \cdot n_{.j})/n$, an abbreviated, unadjusted analysis can be performed which is well described in elementary texts.

As it now stands, the model is indeterminate, and no reasonable analysis can be made. Thus, it is necessary to make certain assumptions about the model or to impose certain conditions to make main effects "estimable". Let us impose the following r + c - 1 conditions:

$$\sum_i n_{ij}\delta_{ij} = 0 \quad \text{for all } j$$

$$\sum_j n_{ij}\delta_{ij} = 0 \quad \text{for all } i$$

These conditions minimize, in effect, the contribution of the interaction. With these conditions, the normal equations become as follows:

$$nm + \underline{n}_{i.}'\underline{a} + \underline{n}_{.j}'\underline{b} = G$$

$$\underline{n}_{i.}m + D_{n_{i.}}\underline{a} + N\underline{b} = \underline{R}$$

$$\underline{n}_{.j}m + N'\underline{a} + Dn_{.j}\underline{b} = \underline{C}$$

Now there are r + c + 1 equations in r + c + 1 unknowns.

By making the r + c - 1 conditions on our original model, we now have a new and more restricted model. Different conditions would have led to different models and hence different analyses.

To solve the equations, we can apply two constraints. Note that the constraints are applied to the estimates of the α and β effects and are only for arithmetic convenience in solving the set of singular equations. Different choices of a pair of constraints would have led to the same analysis.

After some elementary manipulations, we obtain the r "adjusted normal equations",

$$C\underline{a} = \underline{Q}.$$

The typical elements of C are as follows:

$$c_{ii} = n_{i.} - \sum_{j=1}^{c} n_{ij}^2/n_{.j}$$

and

$$c_{ik} = -\sum_{j=1}^{c} n_{ij}n_{kj}/n_{.j} \quad , i \neq k.$$

The typical element of $\underline{Q}$ is

$$Q_i = R_i - \sum_{j=1}^{c} n_{ij}C_j/n_{.j}$$

which is an adjusted row total.

C is symmetric and singular; there are r equations in r unknowns; and the rank of C is r-1. We still have one constraint which we can apply. Let $a_r = 0$. Hence, we now have r-1 equations in r-1 unknowns. Thus, we obtain the solutions $a_1, a_2, \ldots, a_{r-1}$, and $a_r = 0$.

The effects, as such, are not estimable but effect contrasts are. Since additions of a constant to a contrast does not change the contrast, we can add a constant k to our solutions a_i, i=1, ... , r, for mere convenience of representation of the same results.

Had the C matrix been "orthogonal", an estimate of the i^{th} row effect could have been $R_i/n_{i.}$, i.e., the i^{th} row mean, an easily interpretable quantity. This "effect estimate" would satisfy the constrains $\sum n_{i.} a_i^* = G$, the grand total. It is obtained from an a_i based upon another constraint, by addition of a constant k, $a_i^* = a_i + k$, where

$$k = (G - \sum_{i=1}^{r} n_{i.} a_i) / n.$$

Thus, in the non-orthogonal case, it seems convenient, for purposes of interpretation, to use $a_i^* = a_i + k$ where k is defined as above. These a_i^* will be called "adjusted row means". Note that, for the statistician, this would be somewhat inconvenient. He prefers sums or weighted sums of effects to add to zero, so that he may add these in the model equation without having to subtract constants (in our case, the grand mean). To the experimenter, however, a mean is much more useful than effect estimates which are preferable for mathematical convenience. To repeat, these are merely different representations of identical results.

Similarly, for column effects, we calculate, initially,

$$b_j = \frac{C_j - \sum_{i=1}^{r} n_{ij} a_i}{n_{.j}} - \frac{G}{n}$$

For the "adjusted column means", let $b_j^* = b_j + k$ where

$$k = \frac{G - \sum_{j=1}^{c} n_{.j} b_j}{n}$$

3.2 Program TEMAT

Multivariate Analysis of Variance

The likelihood ratio statistic is

$$-m \log(|E|/|H+E|)$$

where m = d.f. error + 1/2(d.f. hypothesis - number of responses - 1),

$|E|$ is the determinant of the matrix of sums of squares and products for error,

H is the matrix of "adjusted" sums of squares and products for each hypotheses (subtotals, interaction, rows, columns, in turn).

The first two terms of the Bernoulli expansion of the distribution, which would be in error by a term of order $1/m^4$, are employed to state at what level of significance the null hypothesis would be rejected. In the (hopefully frequent) case that this level is below 10^{-5}, the result is displayed as zero. Large values (.20 or larger) are desirable only in the interaction test. From time to time, the display for one effect is replaced by the message "MATRIX NOT GRAMIAN". This can have two reasons:

(a) There is linear dependence between the response variables, e.g., one may be the sum of the others. In this case, the multivariate analysis is obviously faulty. A variable should be excluded in the next run.

(b) The approach to the null-hypothesis situation is too close. This is the generalization of the case which produces negative variance-component estimates in univariate analysis. If this happens in an Interaction test, the result is quite desirable. If it happens in a main effect, it contributes nothing. If the "MATRIX NOT GRAMIAN" display occurs in a main effect it simply means that H_0 is to be accepted, and that no interpretation of discriminant functions or main effect differences should be attempted.

In the special case where the hypothesis has only one degree of freedom (2 levels in a factor) the likelihood-ratio test, just as the union-intersection test, reduces to an F statistic (more commonly known as "Hotelling's T^2 - with some minor variation in constants"). In these cases, the F statistic and the associated degrees of freedom are reported. The user would have to compare with F tables to decide on acceptance or rejection of the hypothesis. In our interactive system we have a "Calculator" mode which enables him to look up, i.e., actually compute, the probability levels.

The program also calculates the union-intersection statistic, i.e., the largest characteristic root of $E^{-1}H$ (same definitions as above). The right and left eigenvectors associated with this matrix are also computed and reported, the former being a representation of the discriminant function, the latter being used as a basis for calculating correlations of response variables versus the discriminant functions [2]. The parameters needed for entering the Roy-Heck charts are displayed. There is a practice to use the Beta statistic SSH/(SSH + SSE), usually called R^2, as a measure of goodness of fit of a univariate analysis of variance

model. To satisfy users who like this measure, the corresponding multivariate index ("canonical R^2") is reported. It is, in fact, the largest characteristic root of $(H + E)^{-1}H$.

3.3 Distribution Routines

FUNCTION GAMX(X,DF)

$$P(a,x) = GAMX(x,a) = \frac{1}{\Gamma(a)} \int_0^x e^{-y} y^{a-1} dy$$

If DF < 200, the probabilities are evaluated by a sum of Poisson terms

$$\frac{x^a e^{-x}}{\Gamma(a+1)} \qquad \text{where } a = DF, DF + 1, \ldots$$

If DF > 200, the evaluation is by cubic approximation

$$Gam(X,DF) = YORMX(Y) \quad \text{where } Y = [\sqrt[3]{X/DF} - 1 + 1/9DF] \sqrt{9DF}$$

FUNCTION CHIX(X,DF)

$$P(\gamma,x) = CHIX(X,DF) = \frac{1}{2^{\gamma/2}\Gamma(\gamma/2)} \int_0^x y^{\gamma/2-1} e^{-y/2} dy$$

Since the chi-square distribution is a special case of the gamma distribution, the probabilities are evaluated by the use of the GAMX subroutine where

$$CHIX(X,DF) = GAMX(X/2.,DF/2.)$$

FUNCTION YORMX(X)

$$P(x) = \text{YORMX}(X) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-t^2/2} dt$$

If $|x| < 2.5$, the evaluation of the probabilities employs the Hastings form; otherwise, the Laplace continued fraction is used.

CHAPTER IV

TOOLS FOR THE USER

4.1 User's Guide

The program SPOOK is designed to provide the user with an analysis of irregular data matrices. A univariate analysis (i.e., every score or variable is analyzed separately) is performed, followed by, if desired, a multivariate analysis (where all variables are analyzed as a set).

The univariate analysis may be either a one-way or a two-way classification design. A one-way design is such that the individual experimental units (e.g., individuals, plots of land, animals, etc.) are classified by only one characteristic or factor. A two-way design is based upon the individual experimental units being classified by two characteristics or factors. Each experimental unit is then assigned to one, and only one, category for each factor. Examples of factors would be sex, age, weight, height, etc. Since the conversational unit is designed for two factors, a one-way classification requires special treatment. In this instance, the user should state, when asked, a dummy name (or no name at all) for the first factor and he should further declare that it has just one level. The second factor should then be his only factor.

Each factor must be such that levels may be designated. The designation of levels may be in the form of consecutive numbers such as

a to b or, if the data are continuous, records which fall below a_1 could be regarded as belonging to level 1, records falling between a_1 and a_2 as belonging to level 2, etc. Thus, the levels of a factor such as sex could be designated as 1,2 while the levels of a factor such as age could be designated as

5 - 9 years	level 1	("end code" here is 9)
10 - 14 years	level 2	("end code" here is 14)
15 - 19 years	level 3	("end code" here is 19)
20 - 25 years	level 4	("end code" here is 25).

There can be up to twelve levels for each factor.

For each experimental unit, there may be from one through ten responses to different variables. Examples of response variables would be a test score (or average) in English, a test score in arithmetic, and a test score in science, or the number of situps, number of pushups, time in 100-yard dash, and distance in broad jump. In these examples the experimental units would be individuals, and the factors may be sex, age, school type, etc.

A name or code (maximum of four characters) should be assigned to each factor and each response variable. The naming will be used for identification in the output. In addition to the names, a title might be desired.

Once having collected his data, the user could have a table such as Table 4.1 for quick reference. With such a table he will be able to give answers to the questions asked by the computer.

If the data are voluminous, and punched on cards, the user is advised to refer to the description of BUILD in Chapter 5 so that a

prior batch run can be made to store the data. Because preparation of the input may appear complicated to those with limited programming background, a user who finds the description difficult may wish to consult a somewhat more experienced programmer for the first run. Once the batch run has been made, the input portion of SPOOK is omitted, and the user may proceed as if he had entered his data from the console.

EFFECTIVENESS OF TEACHING

	MALE			FEMALE		
	ENG	ARIT	SCIE	ENG	ARIT	SCIE
PUBLIC	55.1	55.6	46.8	57	47.4	44.8
	56.1	53.2	41.7	55.6	46.3	39.9
	55.9	49.5	38.1	58	51.2	50
	54.4	58.9	39.6	55.9	50.3	39.4
				59.7	49.5	43.1
PRIVATE	52.8	59.4	47.1	55.6	54.8	42.7
	53.6	65.6	42.1	61.7	53	47.1
	53.9	59.2	42.3	56.1	60.8	45.2
	53.8	58.2	45.2	60.3	67.6	49.2
BOARDING	56.7	62.3	49.8	61.8	52.6	48.4
	58.2	64.6	47	55.6	69.9	49.3
	59.6	52.8	49.2	62.3	62.4	50.4
				59.9	54.3	46.2
				60.7	59.4	48.6

Table 4.1

4.2 Example

This section is intended to familiarize the user both with the IBM 2250 display unit and the program SPOOK.

The 2250 display unit is centered around a cathode-ray tube on which computer-programmed information is displayed. Thus, a visual communication exists between the user and the computer. The unit also has an alphameric keyboard similar to a typewriter keyboard. There are 44 keys and a space bar giving 62 standard characters. Special keys of interest to the user are the "ALT" and the "5" keys. When these two keys are depressed simultaneously, the end of a response is signalled. This combination will often be referred to as "end of block" or "EOB". The user should also note the "BACKSPACE" key. This moves the cursor back one space and as long as EOB has not been signalled the user can correct his typed input. To the left of the alphameric keyboard is a program function keyboard which consists of 32 lighted keys numbered 0 - 31. All keys, except key 0, are available to the user. At different points in the program, different keys will have significance, and thus be lighted to help the user remember them.

When the user first sits down in front of the console, he should depress any key (not key 0). Once the instructions appear he should type $LINK SPOOK and then signal EOB ("ALT" and "5" depressed simultaneously).

Even though each frame should be self-explanatory, a typical set of data was constructed and subjected to the program to illustrate the use of SPOOK. The data are shown in Table 4.1. Since one purpose of

this program is to provide a quick means of editing the data, the example will try to illustrate one way to hunt faulty ones.

The first display is shown in Figure 4.1. Several instructions which are of particular importance are as follows: key 30 restarts the program, key 31 will terminate the program, key 2 will allow the user to reenter data, and any remaining key (again, not key 0) will allow him to continue once he has seen the display of his data. The one instruction which needs all the emphasis it can receive is "CAUTION: DO NOT TRY TO SPEED UP THE PROGRAM BY ANSWERING QUESTIONS BEFORE THEY ARE ASKED. THIS WILL ONLY CREATE PROBLEMS." We know there are users who anticipate and answer the next question. They must contain themselves, since all keyboard responses are placed in a queue, and each question expects some response. Once the user gets "out of phase", the best solution is to press key 31 to terminate and then to reenter the program. Even the restart option (key 30) may not correct the situation.

Because the example is being created at the console, key 1 is depressed to begin the question and answer session. The first query is for a study title. The study title is entirely optional and is used to head the output. It may consist of up to 60 characters. The display following the entry of the title is shown in Figure 4.2. The next question is "HOW MANY RESPONSE VARIABLES DO YOU HAVE?" The number 3 is entered and the following message is displayed to the user: "YOU HAVE 3 RESPONSE VARIABLES." As always, to indicate approval, any one of the unused program function keys is depressed.

The next set of questions asks the user for a name (four letters are recognized) for each of the response variables. The purpose of naming each response variable is so that the data will be entered as the user wishes and also so that the user can identify each in the output. Once the names "ENG ARIT SCIE" are displayed and the user has indicated approval, he is asked for a transformation code for each response variable. The query and the user's reply is displayed to him as in Figure 4.3.

Next, the names of the two factors and the number of levels for each is required. Again the naming of the factors is for identification in the output, but if the first factor has more levels than the second factor, the two will be exchanged in the analysis and hence the naming is especially helpful. In this study, the first factor is SEX and has 2 levels, and the second is TYPE and has 3 levels. If there is only one factor (one-way classification analysis) the user should give a dummy name to the "first" factor (or just leave the name blank) and indicate the number of levels (below) as 1. The second factor is then his only one.

Figure 4.4 shows the next display. Since, in our example, all levels are discrete (rather than selected partitions on a continuous scale) and since they further have natural codes 1-2, 1-2-3, key 1 has been depressed. Had key 2 been depressed to indicate continuous levels, Figure 4.5 would have appeared asking for the "end codes" of the levels of each factor. The display in Figure 4.6 is the next one to appear in either case.

Figure 4.7 shows the instructions for entering dat . Note that key 2 is no longer used for reentry of data. Instead, the user types "BACK" and the number of entries which he wishes to go back. Each time this option is used the appropriate number of lines will be erased starting at the bottom of the display. Thus, one cannot change, at this stage, an entry without also reentering all of the following entries. Key 3 will be depressed when the user has entered all of the data. Once key 3 is depressed the user is forced into the univariate analysis. Hence, he should be sure that the data displayed on the console is what is desired at that point.

Depending upon the number of users concurrently on the central processor, waiting time for results may take several minutes even though the central processing time is only a matter of a second or two. Hence, displays similar to the one in Figure 4.8 keep the user posted on progress and allow him to stop the calculations if he wishes. Once key 2 is depressed the program will proceed to the output having performed univariate analyses only on the named variables.

As the display in Figure 4.9 indicates, the user has complete control over what portions of the output he views. Once the user reaches the instructions which follow each set of output, he is not bound to follow them at that point. He can still depress key 3 to decrement the page number and hence continue viewing the analyses more extensively.

Page 1L (Figure 4.10) gives some hints on how to begin looking at the preliminary output. Once the user has checked the F-ratios, adjusted means, and cell means and standard deviations of the univariate analyses

and if he finds nothing abnormal, he should still proceed to the plots of the response variable pairs and to the raw data. Plotting rows, columns, and cells may indicate faulty data. At the plotting segment he should check the upper and lower limits of each variable. This is another good way of checking on faulty data. Because of the many steps in bringing data to be analyzed, faulty data or outliers can easily occur: data can be transcribed incorrectly or have keypunch errors. Thus, the first analysis should never be the last!

Figures 4.11 - 4.16 show the output from this initial run. Let us look first at the variable ENG. The F-values are nonsignificant but a careful inspection does not stop with the ANOVAR table. Looking at the adjusted means, one sees that the means of the second level of each factor seems to be quite out of range. The next place that merits inspection is the table of means and standard deviations. "Deviation from a trend in rows or columns" is a mild way of reporting what is happening in the (2,2) cell. This clearly indicates that the quickest way to find out what is happening is to go to the plotting segment of the program. But, first look at the ARIT and SCIE variables. There is nothing to indicate faulty data in these variables! The data in the two variables should still be investigated by plots and by looking at the raw data.

Figure 4.17 shows the first display once the plotting segment is entered. To begin, the (2,2) cell is what we are interested in, and the best method is to plot ENG against each of the other variates. Figures 4.18 and 4.19 indicate that entry number 17 is the outlier.

Note the upper and lower limits on the ENG variable. Figures 4.20 - 4.22 show plots of other data. After other plots have been investigated for faulty data which did not show in the analysis, depression of key 5 passes control of the program to a display of the raw data. Now, changes can be made. Inspection of entry number 17 shows a misplaced decimal point (a quite common mistake). Depression of key 2 allows the correction to be made as shown in Figure 4.23. Once the correction is made, depression of key 6 will allow the user to see plots again.

Here, it should be emphasized that while the user is in the plotting segment key 5 will take him to the raw data and key 29 will allow him to see the previous univariate analyses. While he views the raw data, key 6 will allow him to see plots (these new plots will include any changes made) and key 29 will allow him to see the previous univariate results. Once the user has performed his first univariate analysis pass, he can always depress key 5 to see raw data or key 6 to see plots. This allows him to go back and forth as often as he wishes in order to make changes. Hence, if he made a change in the data and saw in the plots that he still did not like it, another change could easily be made.

In our example, continuation to a new univariate analysis is now indicated. Figures 4.24 and 4.25 show the new output for the variable ENG. Here, both factors are significant and outliers are no longer indicated. Thus, in the example, the faulty data point did produce obvious changes in the univariate analysis. On the other hand, even where faulty data make no obvious changes in the univariate analysis they could still influence the multivariate analysis in an unpredictable manner.

Once an edited analysis has successfully been made, the user may indicate a multivariate analysis by the depression of key 4. Once the multivariate option has been indicated, the user is given the opportunity to delete any of the response variables. After having studied the univariate results, the user may wish to exclude some of the variables from the multivariate pass. For example, a variable which shows an insignificant F-value even for subtotals serves no good purpose in the multivariate analysis and may dilute it. As each response variable name is displayed on the screen, the user should depress key 1 to include the variable in the multivariate analysis or key 2 to exclude it from the analysis. Once the user has made a decision on each name, he will be given the opportunity to revise his list if he should have made a mistake.

In the example we will include all the variables in the multivariate pass. This will give sample output as seen in Figures 4.27 - 4.30. The multivariate output includes likelihood ratio tests, union-intersection tests, weights of the discriminant functions, correlation between each variable and the discriminant function, E matrix of sums of squares and cross products for error, E^{-1}, and correlation matrices based on E and $H + E$ for each H (see Section 3.2).

At the end of the multivariate output is a message instructing the user to depress key 31 if he wishes to terminate or key 4 for another multivariate analysis which might be indicated to investigate new combinations of response variables. Once again the user is still free to depress key 3 to go back to continue study of the output. Although the data should have been edited completely before the

multivariate analysis, the user may still depress key 6 to see plots or depress key 5 to see raw data.

OUTPUT AREA

THIS PROGRAM IS DESIGNED TO PERFORM AN ANALYSIS OF IRREGULAR DATA. YOU MAY HAVE A MAXIMUM OF 10 RESPONSE VARIABLES AND A MAXIMUM OF 2 FACTORS. YOUR DESIGN MAY BE QUITE UNBALANCED, AND WHOLE CELLS MAY BE MISSING. TRANSFORMATIONS CAN BE MADE. FOR EACH PAIR OF FACTORS, AN ANALYSIS OF VARIANCE IS PERFORMED FOR EACH RESPONSE VARIABLE, SEPARATELY. ONCE YOU SEE THESE UNIVARIATE ANALYSES YOU WILL BE GIVEN THE OPPORTUNITY TO SEE PLOTS OF YOUR DATA AND THE RAW DATA AGAIN. THUS, YOU WILL BE ABLE TO EDIT YOUR DATA AND RUN THE ANALYSES AGAIN. .

TO BEGIN YOU MUST ANSWER QUESTIONS BY USING THE TYPEWRITER KEYBOARD DIRECTLY IN FRONT OF YOU. TO SIGNAL YOUR COMPLETION OF QUESTIONS, FIRST DEPRESS THE "ALT" KEY, AND WHILE HOLDING IT DOWN, DEPRESS THE "5" KEY. THIS SEQUENCE WILL LATER BE REFERRED TO AS "EOB". ONCE YOU ANSWER QUESTIONS, THE ANSWERS WILL BE DISPLAYED BACK TO YOU. IF YOU ARE NOT SATISFIED, PRESS KEY 2 TO REENTER DATA; OTHERWISE, THE PROGRAM WILL CONTINUE BY YOUR PRESSING ANY KEY.

AT ANY TIME YOU MAY RESTART BY PRESSING KEY 30 OR TERMINATE BY PRESSING KEY 31.

CAUTION: DO NOT TRY TO SPEED UP THE PROGRAM BY ANSWERING QUESTIONS BEFORE THEY ARE ASKED. THIS WILL ONLY CREATE PROBLEMS.

IF YOU HAVE PREVIOUSLY USED THIS PROGRAM OR ENTERED YOUR DATA THROUGH BATCH MODE, PRESS KEY 2 TO SEE YOUR DATA.

PRESS KEY 1 TO PROCEED.

REPLY AREA

Figure 4.1

OUTPUT AREA

IF YOU DESIRE TO HAVE A TITLE TO HEAD YOUR OUTPUT, ENTER IT NOW.
IF YOU DO NOT DESIRE A TITLE, LEAVE THE RESPONSE AREA BLANK.

YOUR TITLE IS
EFFECTIVENESS OF TEACHING

REPLY AREA

Figure 4.2

OUTPUT AREA

FOR EACH RESPONSE VARIABLE ENTER A TRANSFORMATION CODE FROM THE FOLLOWING LIST:

CODE	TRANSFORMATION
0,1	NO TRANSFORMATION
2	LOGE(X) (X>0)
3	LOGE(1+X) (X>-1)
4	SQRT(X) (X>=0)
5	1/X (X>0)
6	ARCSIN(2X-1) (0<X<1) VARIANCE-STABILIZING TRANSFORMATION FOR PROPORTIONS
7	AVAILABLE (NOW: NO TRANSFORMATION)

SEPARATE ALL ANSWERS BY COMMAS.

ENG	ARIT	SCIE
1	1	1

REPLY AREA

Figure 4.3

OUTPUT AREA

YOUR FACTORS SHOULD BE IN DISCRETE LEVELS AS 1,2,...,12. BUT
IF YOUR DATA IS CONTINUOUS, GROUPING CAN BE DONE FOR YOU.
IF YOUR LEVELS ARE ALREADY DISCRETELY DEFINED, PRESS KEY 1.
IF YOUR DATA IS CONTINUOUS, PRESS KEY 2.

REPLY AREA

Figure 4.4

OUTPUT AREA

```
TO GROUP THE DATA, ASSIGN EACH LEVEL OF THE FACTOR AN "END CODE"
OR AN IDENTIFIER;  EG, IF ONE OF THE FACTORS IS AGE RANGING FROM
5 YEARS TO 25 YEARS, WE MAY WISH TO ASSIGN AGES TO LEVELS AS
     5- 9 YEARS    LEVEL 1
    10-14 YEARS    LEVEL 2
    15-19 YEARS    LEVEL 3
    20-25 YEARS    LEVEL 4
THEN THE END CODE FOR LEVEL 1 WOULD BE 9, THE END CODE FOR
LEVEL 2 WOULD BE 14, ETC.
THIS DATA WOULD BE ENTERED AS   9,14,19,25

WHAT ARE THE "END CODES" FOR THE  2 LEVELS OF FACTOR SEX ?
WHAT ARE THE "END CODES" FOR THE  3 LEVELS OF FACTOR TYPE?
```

REPLY AREA

Figure 4.5

OUTPUT AREA

```
THE "END CODES" FOR THE  2 LEVELS OF FACTOR SEX
  1   2
THE "END CODES" FOR THE  3 LEVELS OF FACTOR TYPE
  1   2   3
```

REPLY AREA

Figure 4.6

OUTPUT AREA

NOW YOU MUST SUPPLY THE DATA. YOU WILL NEED TO INDICATE THE LEVELS OF THE FACTORS AND THE RESPONSE OF EACH VARIABLE.

EXAMPLE: 2,7,412,34,5
INDICATES FACTOR 1 IS AT LEVEL 2, FACTOR 2 IS AT LEVEL 7, THE RESPONSE FOR VARIABLE 1 IS 412, THE RESPONSE FOR VARIABLE 2 IS 34, AND THE RESPONSE FOR VARIABLE 3 IS 5.

IF YOU WANT TO OMIT DATA ON A PARTICULAR RANDOM VARIABLE, REPLACE IT BY -999.

EXAMPLE: 2,7,412,-999,5
INDICATES THAT THE DATA FOR THE SECOND RESPONSE VARIABLE IS OMITTED.

WHEN YOU HAVE ENTERED ALL DATA, PRESS KEY 3.

SHOULD YOU REALIZE YOU HAVE A MISTAKE IN YOUR DATA, TYPE "BACK" AND THE NUMBER OF ENTRIES YOU WISH TO GO BACK.

WHEN YOU ARE READY TO ENTER YOUR DATA, PRESS KEY 1.

REPLY AREA

Figure 4.7

OUTPUT AREA

THE ANALYSES ON THE FOLLOWING VARIABLES ARE NOW COMPLETE.
ENG ARIT

PRESS KEY 1 TO CONTINUE WITH CALCULATIONS OR KEY 2 TO STOP CALCULATIONS AT THIS STAGE.

REPLY AREA

Figure 4.8

OUTPUT AREA

KEYBOARD FUNCTIONS:
1 ALTERNATE PORTION OF CURRENT PAGE.
2 INCREMENT PAGE NUMBER.
3 DECREMENT PAGE NUMBER.
30 RESTART PROGRAM.
31 TERMINATE PROGRAM.

PRESS KEY 1 TO PROCEED TO THE FIRST PAGE OF YOUR UNIVARIATE RESULTS.

REPLY AREA

Figure 4.9

OUTPUT AREA

PAGE 1L

AT THIS POINT YOU SHOULD INSPECT YOUR UNIVARIATE RESULTS VERY CAREFULLY.

IS THERE A LARGE INTERACTION VERSUS ERROR F-RATIO?
THIS MAY INDICATE THE PRESENCE OF OUTLIERS OR FAULTY DATA.

CHECK THE TABLE OF CELL TOTALS OF VARIABLES WITH LARGE F-RATIOS FOR LARGE STANDARD DEVIATIONS OR FOR A CELL MEAN WHICH DEVIATES IRREGULARLY FROM A TREND IN ROWS OR COLUMNS.

AFTER YOU HAVE CHECKED THESE RESULTS YOU CAN CHECK AND EDIT YOUR DATA.

REPLY AREA

Figure 4.10

OUTPUT AREA

PAGE 2L

EFFECTIVENESS OF TEACHING

VARIABLE (ENG) TABLE OF MEANS

ROWS = SEX CODED LEV. 1 COLUMNS = TYPE
IN EACH BLOCK, ROW 1 DENOTES CELL MEANS, ROW 2 DENOTES CODED LEVELS

	1	2	3	
1	5.537E 01	5.352E 01	5.817E 01	5.546E 01
	4	4	3	11
	7.798E-01	5.000E-01	1.450E 00	
2	5.724E 01	5.842E 01	6.006E 01	5.859E 01
	5	4	5	14
	1.671E 00	3.635E 00	2.664E 00	
COL.				
	5.641E 01	5.597E 01	5.935E 01	5.721E 01
	9	8	8	25

ESTIMATES OF SEX ADJUSTED MEANS, ORDERED

2	1
5.847E 01	5.561E 01

ESTIMATES OF TYPE ADJUSTED MEANS, ORDERED

3	1	2
5.916E 01	5.642E 01	5.615E 01

ANALYSIS OF VARIANCE FOR VARIABLE ENG

SOURCE OF VARIATION	D.F.	SUM OF SQUARES
SEX (ROWS)	1	5.019498E 01
TYPE (COLS)	2	4.413355E 01
SEX * TYPE(INTERACTION)	2	1.227552E 01
SUBTOTALS	5	1.170524D 02
ERROR	19	7.397502D 01
TOTAL	24	1.910274D 02

REPLY AREA

Figure 4.11

OUTPUT AREA

AND EFFECTS (SEX) VERSUS (TYPE).

CELL SIZE, AND ROW 3 DENOTES STANDARD DEVIATION.

MEAN SQUARE	F VS. ERROR	F VS. INTERACTION
1.175292E 04	1.207E 00	1.065E 00
1.127447E 04	1.158E 00	1.022E 00
1.103074E 04	1.133E 00	
1.078300E 04	1.107E 00	
9.739313E 03		
9.956746E 03		

ROOT MEAN SQUARE ERROR = 9.868796E 01
ROOT MEAN SQUARE INTERACTION = 1.050273E 02

REPLY AREA

Figure 4.12

OUTPUT AREA

PAGE 3L

EFFECTIVENESS OF TEACHING

VARIABLE (ARIT) TABLE OF MEANS

ROWS = SEX CODED LEV. IN EACH BLOCK, ROW 1 DENOTES CELL MEANS, ROW 2 DENOTES

COLUMNS = TYPE CODED LEVELS

	1	2	3	
1	5.430E 01	6.060E 01	5.990E 01	5.812E 01
	4	4	3	11
	3.962E 00	3.374E 00	6.255E 00	
2	4.894E 01	5.905E 01	5.972E 01	5.568E 01
	5	4	5	14
	2.038E 00	6.604E 00	6.910E 00	
COL.	5.132E 01	5.982E 01	5.979E 01	5.675E 01
	9	8	8	25

ESTIMATES OF SEX ADJUSTED MEANS, ORDERED

1	2
5.816E 01	5.564E 01

ESTIMATES OF TYPE ADJUSTED MEANS, ORDERED

3	2	1
5.995E 01	5.967E 01	5.131E 01

ANALYSIS OF VARIANCE FOR VARIABLE ARIT

SOURCE OF VARIATION	D.F.	SUM OF SQUARES
SEX (ROWS)	1	3.863693E 01
TYPE (COLS)	2	4.165764E 02
SEX * TYPE(INTERACTION)	2	3.007245E 01
SUBTOTALS	5	4.833116D 02
ERROR	19	4.979627D 02
TOTAL	24	9.812743D 02

REPLY AREA

Figure 4.13

OUTPUT AREA

PAGE 3R

AND EFFECTS (SEX) VERSUS (TYPE)

CELL SIZE, AND ROW 3 DENOTES STANDARD DEVIATION.

MEAN SQUARE	F VS. ERROR	F VS. INTERACTION
3.863693E 01	1.474E 00	2.570E 00
2.082882E 02	7.947E 00	1.385E 01
1.503622E 01	5.737E-01	
9.666231E 01	3.688E 00	
2.620856E 01		
4.088643E 01		

ROOT MEAN SQUARE ERROR = 5.119430E 00
ROOT MEAN SQUARE INTERACTION = 3.877651E 00

REPLY AREA

Figure 4.14

OUTPUT AREA

PAGE 4L

EFFECTIVENESS OF TEACHING

VARIABLE (SCIE) TABLE OF MEANS

ROWS = SEX IN EACH BLOCK, ROW 1 DENOTES CELL MEANS, ROW 2 DENOTES
COLUMNS = TYPE
CODED LEV. CODED LEVELS

	1	2	3	
1	4.155E 01	4.417E 01	4.867E 01	4.445E 01
	4	4	3	11
	3.798E 00	2.410E 00	1.474E 00	
2	4.344E 01	4.605E 01	4.858E 01	4.602E 01
	5	4	5	14
	4.297E 00	2.767E 00	1.543E 00	
COL.				
	4.260E 01	4.511E 01	4.861E 01	4.533E 01
	9	8	8	25

ESTIMATES OF SEX ADJUSTED MEANS, ORDERED

2	1
4.589E 01	4.461E 01

ESTIMATES OF TYPE ADJUSTED MEANS, ORDERED

3	2	1
4.853E 01	4.519E 01	4.261E 01

ANALYSIS OF VARIANCE FOR VARIABLE SCIE

SOURCE OF VARIATION	D.F.	SUM OF SQUARES
SEX (ROWS)	1	9.946443E 00
TYPE (COLS)	2	1.482998E 02
SEX * TYPE(INTERACTION)	2	5.036934E 00
SUBTOTALS	5	1.686363D 02
ERROR	19	1.714142D 02
TOTAL	24	3.400505D 02

REPLY AREA

Figure 4.15

OUTPUT AREA

AND EFFECTS (SEX) VERSUS (TYPE)

CELL SIZE, AND ROW 3 DENOTES STANDARD DEVIATION.

MEAN SQUARE	F VS. ERROR	F VS. INTERACTION
9.946443E 00	1.102E 00	3.949E 00
7.414990E 01	8.219E 00	2.944E 01
2.518467E 00	2.792E-01	
3.372726E 01	3.738E 00	
9.021797E 00		
1.416877E 01		

ROOT MEAN SQUARE ERROR = 3.003631E 00
ROOT MEAN SQUARE INTERACTION = 1.586967E 00

REPLY AREA

Figure 4.16

OUTPUT AREA

AT THIS STAGE YOU MAY LOOK AT PLOTS OF YOUR DATA POINTS.
YOU HAVE THE CHOICE OF SEEING A CELL, A ROW, A COLUMN, OR
ALL YOUR DATA. TO INDICATE YOUR CHOICE OF POINTS, TYPE IN
THE LEVELS OF BOTH FACTORS. IF YOU WISH TO SEE ALL LEVELS
OF A FACTOR TYPE "0" FOR THE LEVEL.

EXAMPLE:		
	2,2	INDICATES BOTH LEVELS AT 2.
	0,4	INDICATES THE 4TH COLUMN.
	3,0	INDICATES THE 3RD ROW.
	0,0	INDICATES ALL POINTS.

WHICH SET OF POINTS DO YOU WISH TO SEE?

WHICH TWO RESPONSE VARIABLES DO YOU WISH TO SEE?
PLEASE ENTER THE FIRST, EOB, AND THE SECOND, EOB.

REPLY AREA

Figure 4.17

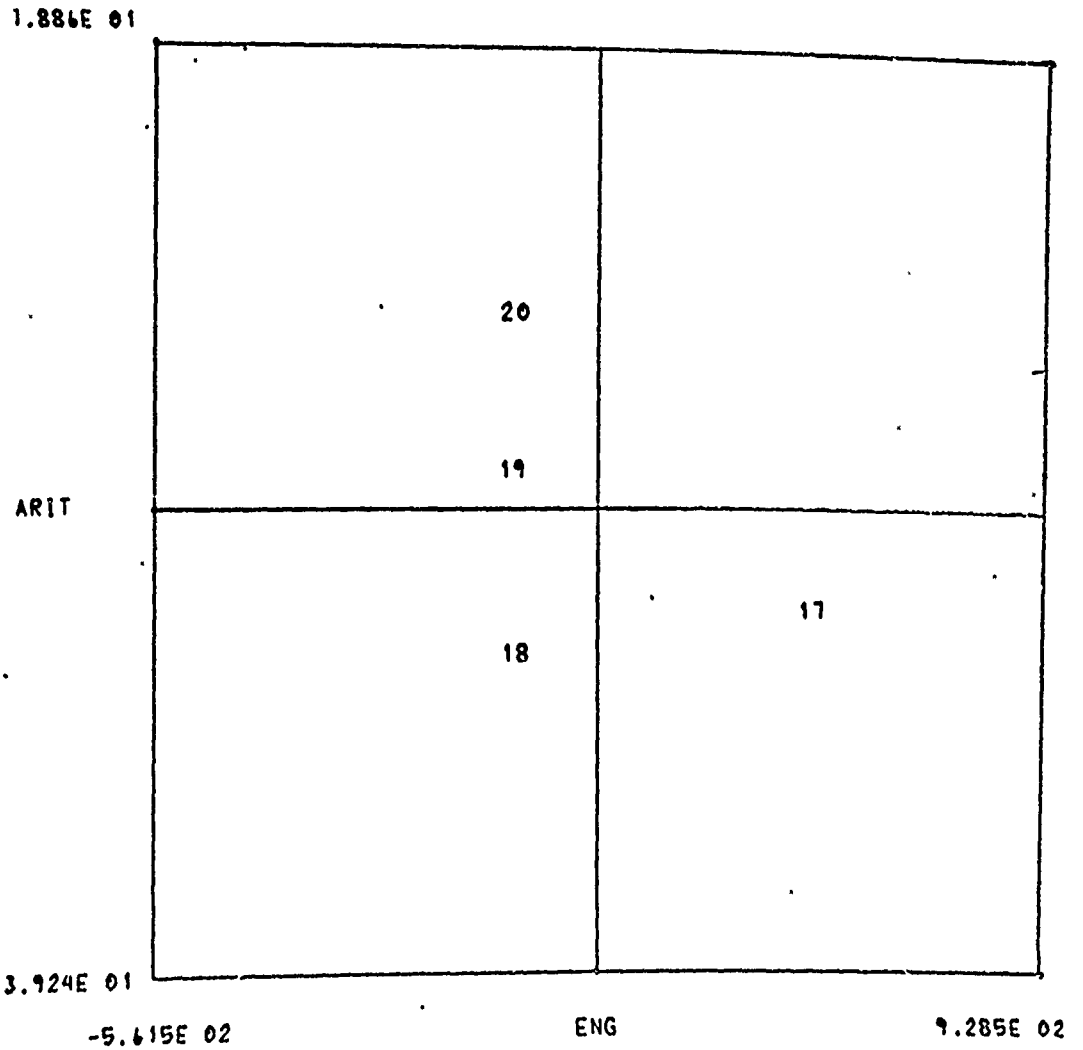


Figure 4.18

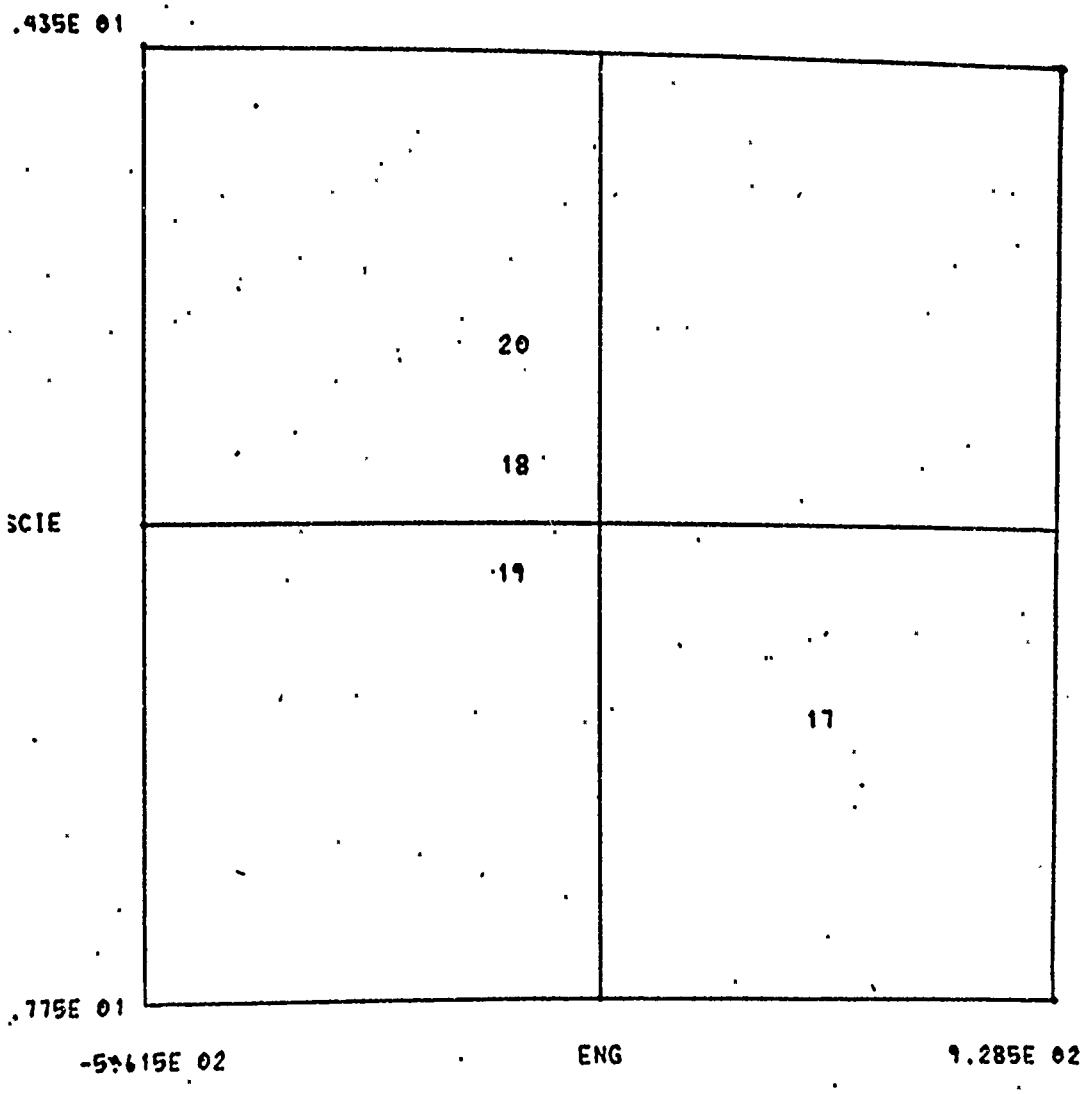


Figure 4.19

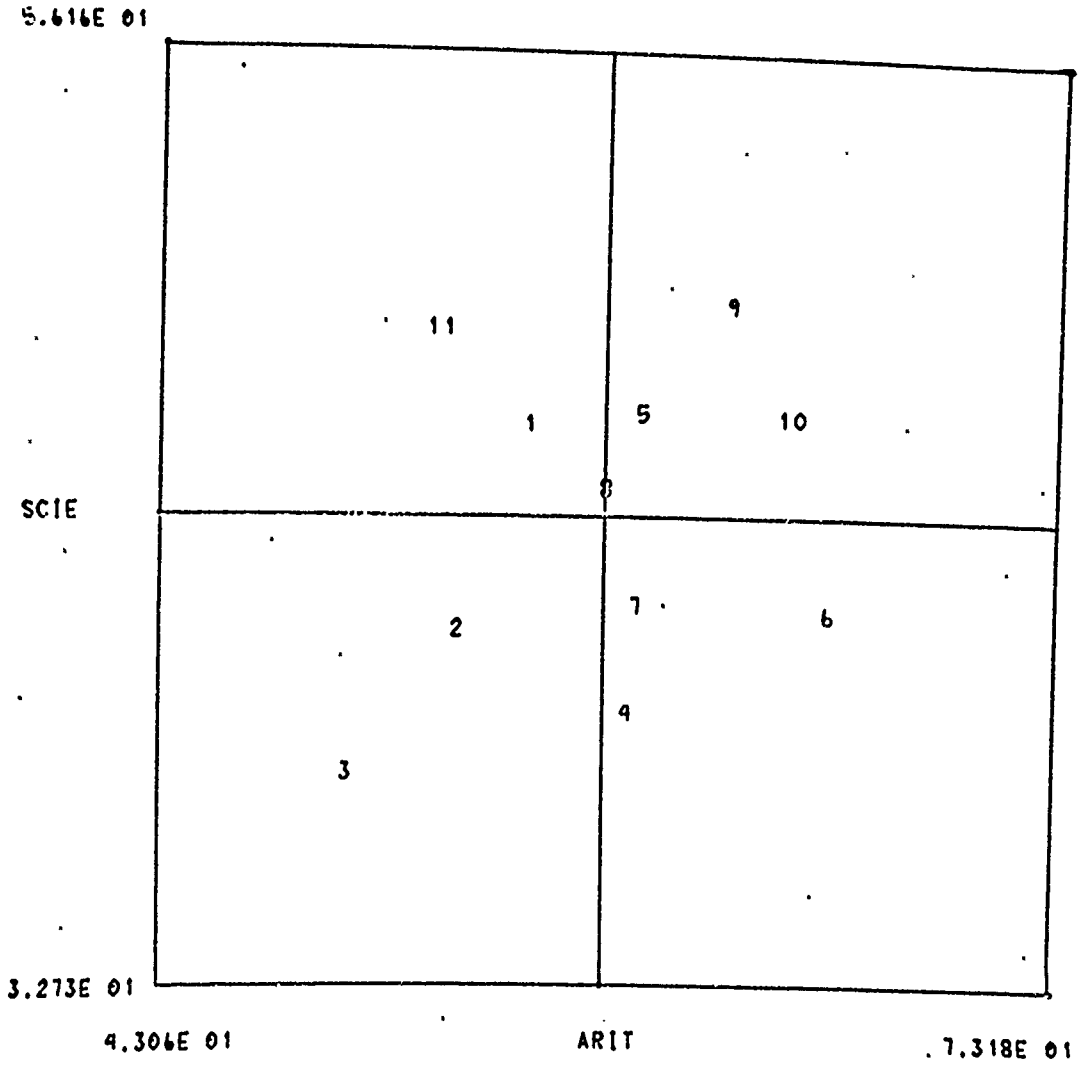


Figure 4.20

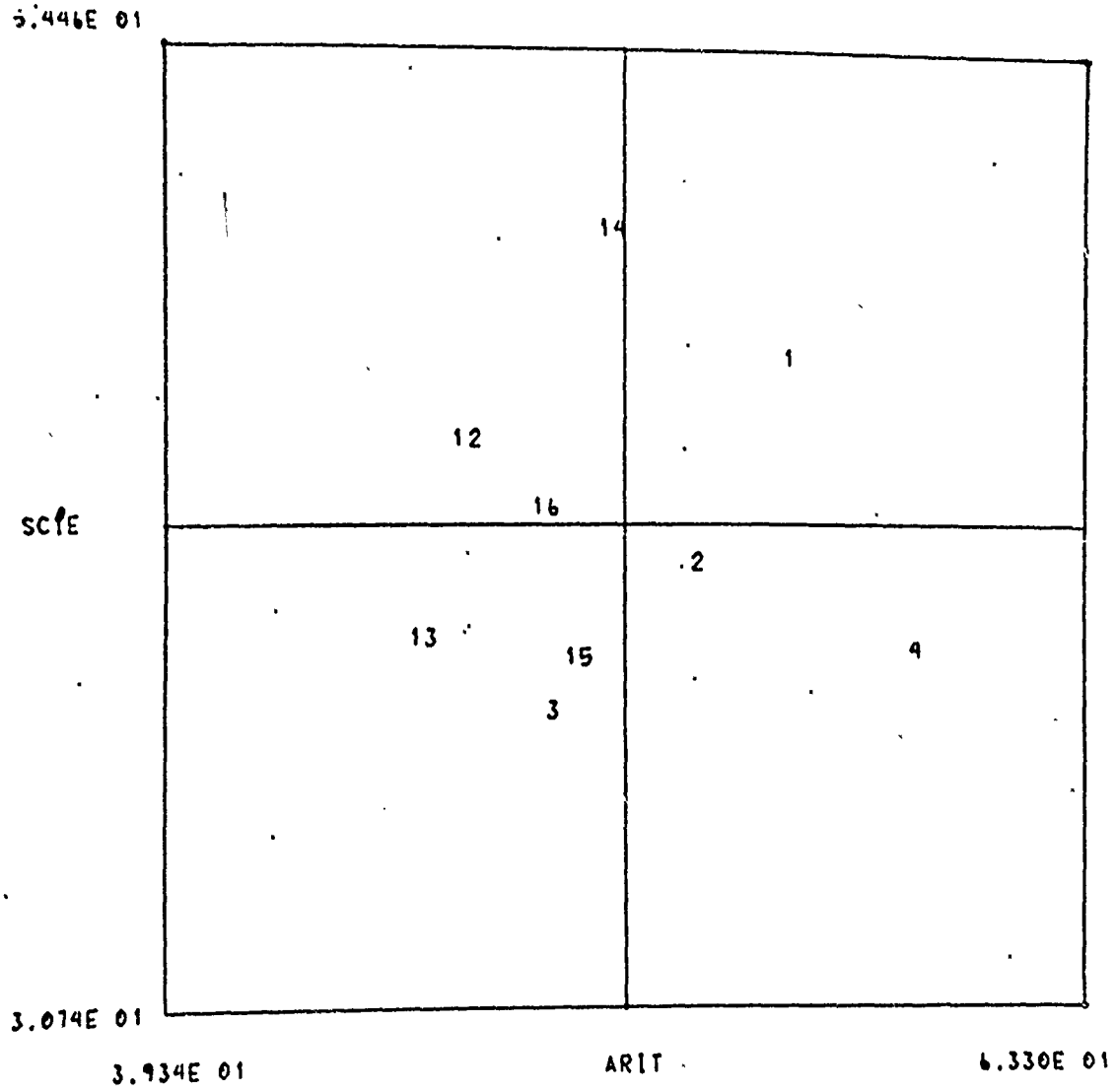

3.446E 01
14
1
12
16
SCALE
2
13
15
4
3
3.074E 01
3.934E 01
ARIT
6.330E 01

Figure 4.21

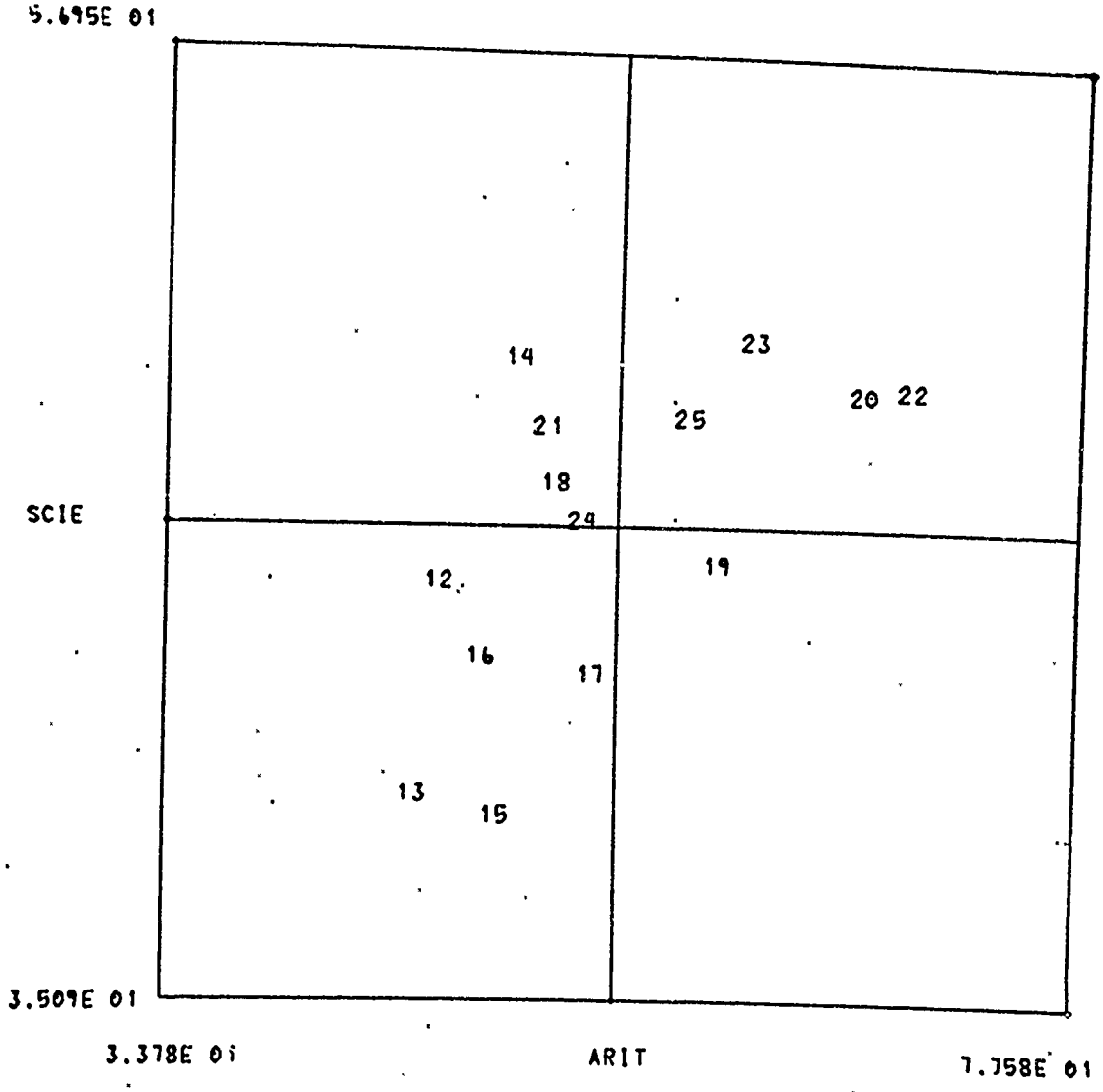

5.695E 01
14
23
20 22
21
25
18
SCIE
24
19
12
16
17
13
15
3.509E 01
3.378E 01
ARIT
7.758E 01

Figure 4.22

OUTPUT AREA

	SEX	TYPE	ENG	ARIT	SCIE
1	1	1	5.510E 01	5.560E 01	4.680E 01
2	1	1	5.610E 01	5.320E 01	4.170E 01
3	1	1	5.590E 01	4.950E 01	3.810E 01
4	1	1	5.440E 01	5.890E 01	3.960E 01
5	1	2	5.280E 01	5.940E 01	4.710E 01
6	1	2	5.360E 01	6.560E 01	4.210E 01
7	1	2	5.390E 01	5.920E 01	4.230E 01
8	1	2	5.380E 01	5.820E 01	4.520E 01
9	1	3	5.670E 01	6.230E 01	4.980E 01
10	1	3	5.820E 01	6.460E 01	4.700E 01
11	1	3	5.960E 01	5.280E 01	4.920E 01
12	2	1	5.700E 01	4.740E 01	4.480E 01
13	2	1	5.560E 01	4.630E 01	3.990E 01
14	2	1	5.800E 01	5.120E 01	5.000E 01
15	2	1	5.590E 01	5.030E 01	3.940E 01
16	2	1	5.970E 01	4.950E 01	4.310E 01
17	2	2	5.560E 02	5.480E 01	4.270E 01
18	2	2	6.170E 01	5.300E 01	4.710E 01
19	2	2	5.610E 01	6.080E 01	4.520E 01
20	2	2	6.030E 01	6.760E 01	4.920E 01
21	2	3	6.180E 01	5.260E 01	4.840E 01
22	2	3	5.560E 01	6.990E 01	4.930E 01
23	2	3	6.230E 01	6.240E 01	5.040E 01
24	2	3	5.990E 01	5.430E 01	4.620E 01
25	2	3	6.070E 01	5.940E 01	4.860E 01

REPLY AREA

Figure 4.23

OUTPUT AREA

PAGE 2L

EFFECTIVENESS OF TEACHING

VARIABLE (ENG) TABLE OF MEANS

ROWS = SEX COLUMNS = TYPE

IN EACH BLOCK, ROW 1 DENOTES CELL MEANS, ROW 2 DENOTES

CODED LEV.	1	2	3	
1	5.537E 01 (4)	5.352E 01 (4)	5.817E 01 (3)	5.546E 01 (11)
	7.798E-01	5.000E-01	1.450E 00	
2	5.724E 01 (5)	1.835E 02 (4)	6.006E 01 (5)	9.433E 01 (14)
	1.671E 00	2.483E 02	2.664E 00	
COL.	5.641E 01 (9)	1.185E 02 (8)	5.935E 01 (8)	7.723E 01 (25)

ESTIMATES OF SEX ADJUSTED MEANS, ORDERED

2	1
9.655E 01	5.264E 01

ESTIMATES OF TYPE ADJUSTED MEANS, ORDERED

2	1	3
1.212E 02	5.661E 01	5.650E 01

ANALYSIS OF VARIANCE FOR VARIABLE ENG

SOURCE OF VARIATION	D.F.	SUM OF SQUARES
SEX (ROWS)	1	1.175292E 04
TYPE (COLS)	2	2.254894E 04
SEX * TYPE (INTERACTION)	2	2.206148E 04
SUBTOTALS	5	5.391499D 04
ERROR	19	1.850470D 05
TOTAL	24	2.389620D 05

REPLY AREA

Figure 4.24

OUTPUT AREA

AND EFFECTS (SEX) VERSUS (TYPE)

CELL SIZE, AND ROW 3 DENOTES STANDARD DEVIATION.

MEAN SQUARE	F VS. ERROR	F VS. INTERACTION
5.019498E 01	1.289E 01	8.178E 00
2.236678E 01	5.745E 00	3.644E 00
6.137757E 00	1.576E 00	
2.341048E 01	6.013E 00	
3.893421E 00		
7.959476E 00		

ROOT MEAN SQUARE ERROR = 1.973175E 00
ROOT MEAN SQUARE INTERACTION = 2.477449E 00

REPLY AREA

Figure 4.25

OUTPUT AREA

YOUR RESPONSE VARIABLE NAMES WILL APPEAR BELOW ONE AT A TIME.
PRESS KEY 1 IF YOU WISH TO INCLUDE THE VARIABLE OR KEY 2 IF
YOU WISH TO DELETE THE VARIABLE.

ENG
ARIT
SCIE

THE ABOVE VARIABLES ARE THE ONES YOU DECIDED TO INCLUDE.
IF YOU AGREE, PRESS KEY 1; IF YOU WOULD LIKE TO TRY AGAIN,
PRESS KEY 2.

REPLY AREA

Figure 4.26

OUTPUT AREA

PAGE 4L

EFFECTIVENESS OF TEACHING

MULTIVARIA

MATRIX E AFTER ELIMINATION OF FA

	ENG	ARIT	SCIE
ENG	7.3975E 01	-6.2622E 01	3.1886E 01
ARIT	-6.2622E 01	4.9796E 02	6.7739E 01
SCIE	3.1886E 01	6.7739E 01	1.7141E 02

STEPWISE LOG DETERMINANTS

ENG	ARIT	SCIE
4.3037E 00	1.0402E 01	1.5325E 01

CORRELATIONS BASED ON E

	ENG	ARIT	SCIE
ENG	1.0000E 00	-3.2628E-01	2.8316E-01
ARIT	-3.2628E-01	1.0000E 00	2.3186E-01
SCIE	2.8316E-01	2.3186E-01	1.0000E 00

SUBTOTALS (ALL EFFECTS) SEX AND

LIKELIHOOD RATIO TEST STATISTIC, CHI-SQUARE = 0.3737E 02 WITH
SIGNIFICANT AT LEVEL 0.126E-02

MATRIX H+E

	ENG	ARIT	SCIE
ENG	1.9106E 02	-3.9992E 01	1.3580E 02
ARIT	-3.9992E 01	9.8129E 02	2.4725E 02
	ENG	ARIT	SCIE

REPLY AREA

Figure 4.27

OUTPUT AREA

PAGE 51

SCIE 1.3580E 02 2.4725E 02 3.4008E 02

CORRELATIONS BASED ON H+E

	ENG	ARIT	SCIE
ENG	1.0000E 00	-9.2361E-02	5.3272E-01
ARIT	-9.2361E-02	1.0000E 00	4.2799E-01
SCIE	5.3272E-01	4.2799E-01	1.0000E 00

STANDARDIZED ROY STATISTIC OR SQUARE OF A CANONICAL CORRELATION =
READ HECK CHARTS WITH S = 3 M = 0.5 N = 7.5

WEIGHT OF DISCRIMINANT FUNCTION

ENG	ARIT	SCIE
4.6257E-02	1.2249E-02	8.4362E-03

CORRELATIONS BETWEEN DISCRIMINANT FUNTION AND ORIGINAL VARIABLES

ENG	ARIT	SCIE
7.3635E-01	3.6639E-01	6.2056E-01

INTERACTION SEX * TYPE

LIKELIHOOD RATIO TEST STATISTIC, CHI-SQUARE.= 0.5889E 01 WITH
SIGNIFICANT AT LEVEL 0.437E 00

MATRIX H+E

	ENG	ARIT	SCIE
ENG	8.6326E 01	-5.6571E 01	3.5484E 01
ARIT	-5.6571E 01	5.2809E 02	5.9087E 01
SCIE	3.5484E 01	5.9087E 01	1.7649E 02

CORRELATIONS BASED ON H+E

REPLY AREA

Figure 4.28

OUTPUT AREA

PAGE 6L

	ENG	ARIT	SCIE
ENG	1.0000E 00	-2.6495E-01	2.8748E-01
ARIT	-2.6495E-01	1.0000E 00	1.9354E-01
SCIE	2.8748E-01	1.9354E-01	1.0000E 00

STANDARDIZED ROY STATISTIC OR SQUARE OF A CANONICAL CORRELATION =
READ HECK CHARTS WITH S = 2 M = .0.0 N = 7.5

WEIGHT OF DISCRIMINANT FUNCTION

ENG	ARIT	SCIE
5.1753E-02	1.5122E-02	-1.6132E-02

CORRELATIONS BETWEEN DISCRIMINANT FUNTION AND ORIGINAL VARIABLES

ENG	ARIT	SCIE
6.6301E-01	3.4509E-01	-1.6703E-02

SEX EFFECTS

TEST STATISTIC F = 3.8465 WITH 3. AND 17. D.F.

WEIGHT OF DISCRIMINANT FUNCTION

ENG	ARIT	SCIE
9.4707E-02	-7.1749E-04	1.0651E-03

CORRELATIONS BETWEEN DISCRIMINANT FUNTION AND ORIGINAL VARIABLES

ENG	ARIT	SCIE
9.9981E-01	-3.3809E-01	2.9237E-01

TYPE EFFECTS

LIKELIHOOD RATIO TEST STATISTIC, CHI-SQUARE = 0.2271E 02 WITH
SIGNIFICANT AT LEVEL 0.920E-03

MATRIX H+E

REPLY AREA

Figure 4.29

OUTPUT AREA

PAGE 7L

	ENG	ARIT	SCIE
ENG	1.1871E 02	9.0370E-01	1.0189E 02

	ENG	ARIT	SCIE
ARIT	9.0370E-01	9.1454E 02	2.7959E 02

	ENG	ARIT	SCIE
SCIE	1.0189E 02	2.7959E 02	3.1971E 02

CORRELATIONS BASED ON H+E

	ENG	ARIT	SCIE
ENG	1.0000E 00	2.7427E-03	5.2303E-01

	ENG	ARIT	SCIE
ARIT	2.7427E-03	1.0000E 00	5.1707E-01

	ENG	ARIT	SCIE
SCIE	5.2303E-01	5.1707E-01	1.0000E 00

STANDARDIZED ROY STATISTIC OR SQUARE OF A CANONICAL CORRELATION =
READ HECK CHARTS WITH S = 2 M = 0.0 N = 7.5

WEIGHT OF DISCRIMINANT FUNCTION

ENG	ARIT	SCIE
3.4649E-02	1.5876E-02	1.3041E-02

CORRELATIONS BETWEEN DISCRIMINANT FUNTION AND ORIGINAL VARIABLES

ENG	ARIT	SCIE
4.7968E-01	6.1658E-01	7.0105E-01

REPLY AREA

Figure 4.30

CHAPTER V

COMPUTER PROGRAMS

The computer programs were written in FORTRAN IV for the IBM 360 Model 65 and operate under Graphics Monitor System (GMS). Extensive use is made of the COMFORT and COMPLOT graphics subroutine packages. The computational routines are from the MUDAID program, thus for more complete documentation, the reader is referred to A FORTRAN II PROGRAM FOR MUDAID: Multivariate, Univariate, and Discriminant Analysis of Irregular Data.

A load module under GMS is limited to 140K of core storage, and thus to reduce the size of the program an overlay structure was utilized. A main program or root was developed to control the flow of the program, and the remaining subroutines of the program were divided into segments which were not needed in core at the same time. Hence, several subroutines use the same core storage at different times. The overlay structure and listing of the job control cards are found at the end of this chapter.

This program uses five different data sets. Unit 11 (NW1) is a sequential file and is used to store the transformed data. Unit 12 (NW2) is also a sequential file and is used to store intermediate results and to pass them between overlays. Units 16, 17, and 38 are all direct access files. Units 16 (N1) and 17 (N2) each have 1980 records of 80 characters in length, are written under format control, and the associated variables are, respectively, IREC1 and IREC2. N1 and N2 are used to display output.

Unit 38 (N3) has 510 records of 80 characters in length, is written either with or without format control, and the associated variable is IREC3. N3 is used to store raw data for display and also to store selected common variables. N3 may be built within SPOOK or through the batch use of BUILD.

The main program serves as "traffic controller" to call the various subroutines. The order in which the subroutines is called depends largely on the variable N which is the number of the program function key depressed by the user. The main program also initially sets the variable MULT = 1 which forces the user to proceed through the univariate pass.

MAINA

This subroutine serves as control for the INPUT and PMATX subroutines. Once the multivariate option is indicated, MAINA only calls the subroutine PMATX.

INPUT

This subroutine is the main conversation unit of the entire program. By asking questions of the user, INPUT receives the raw data and provides the initial processing and storing of the data for future use.

In the general instructions, the user finds that key 30 can be depressed at any time to restart the program and that key 31 is the "panic button", i.e., any time it is depressed the program terminates. Each time the user answers a question, the answer will be displayed back to him and then he must either depress key 2 to reenter his response or any other key (not 30 or 31) to continue with the program. If an answer does not

fulfill the specific requirements, it will be displayed with an error message asking for the reentry of the response. Here, the program begins by asking the user if he has used the program previously or if he has entered his data by the use of the program BUILD. If the answer to this question is yes, the user is instructed to press program function key 2 to branch to statement 1001; otherwise, depression of key 1 will allow him to continue with the program and building of data.

The first query is for a study name header. This can be any combination of characters up to 60 characters in length. The title is optional and is used only for the heading of the output.

Beginning in statement 213 the user is asked for the number of response variables in his study. This number may range from one up to and including ten. If the number is not in this range, an error message is displayed asking for reentry of the response. In the 215 loop the user is asked to give each response variable a four character name or code so that he will be able to identify each variable in the output.

Each response variable can have a transformation assigned to it by the user selecting a code from the following list:

Code	Transformation
0, 1	no transformation
2	$\log_e(x)$ $(x > 0)$
3	$\log_e(1+x)$ $(x > -1)$
4	$\sqrt{x}$ $(x \geq 0)$
5	$1/x$ $(x > 0)$
6	$\arcsin(2x-1)$ $(0 < x < 1)$
7	available (now: no transformation)

A check is made to insure that the codes selected by the user are from the above list; if not, an error message appears. If the data assigned to a variable is "illegal" for the particular transformation, the data in question will then be set to -999 and thus later be ignored in the processing of data. An example of "illegal data" would be the square root or $\log_e$ of a negative number.

Because of limited space in the conversational mode, the user is limited to only two factors. As with the response variables, in loop 226 the user is asked to give each factor a four character name or code. Each factor may have a maximum of twelve levels. If the user has continuous data, the data will be encoded into levels by the user supplying "end codes". If one of the factors is age ranging from 5 to 25 years and is to grouped as follows:

5 - 9 years	level 1
10 - 14 years	level 2
15 - 19 years	level 3
20 - 25 years	level 4

the end codes would be 9, 14, 19, and 25. Loop 844 provides the encoding of the levels.

The last of the conversational segment is the entering of the data. The user is asked to indicate the level of each factor and the response of each variable. If the data on a particular variable is to be omitted, the user is instructed to enter -999 and thus the data will be later ignored.

Immediately after each set of data is entered, the raw data is displayed back and is also placed on direct access unit 38 for future

use in the 1001 segment of INPUT. Then the 106 loop places the factor levels into the coded levels, the 102 loop processes the variable responses through the appropriate transformations, and the data is stored on NW1 for future use.

Program function key 2 is no longer used to reenter data. Instead, the user types "BACK" and the number of entries he wants to go back. Then in the 380 loop the appropriate number of entries is removed from the screen, and NW1 and N3 are reset to the appropriate places. If only the work "BACK" is entered, only one entry is removed.

When all the data have been entered, the user depresses key 3 to indicate this. Control is then passed back to MAINA to begin the calculations.

The last segment of the INPUT routine begins at statement 1001 and is not accessible to the user until he has either seen the univariate results or has previously entered his data. The raw data are displayed from N3 and the segment allows the user to edit his data. To delete a record, the user types "DROP" and the subject number. The variable responses are then replaced by -999 which is always ignored in the calculations. To add data, the user gives the next subject number and the new record. The variable NSUBJ (number of data records) is then incremented. To change a record, the user types the record number and the new record. At this stage, changes are made only on the N3 unit. Once all the changes to the data are made, new transformations may be indicated. The data are then read from N3, reprocessed through the 106 and 102 loops, and stored on NW1 before the subroutine is left.

While in this segment of INPUT, the user may return to his previous univariate analysis output by depression of key 29 or to the plots of his data by depression of key 6.

A flow chart of this subroutine is included at the end of this chapter.

PMATX

This subroutine processes the data stored by INPUT on NW1. An initial decision is made depending on the value of the variable MULT. If MULT = 1, a univariate analysis is made; if MULT = 0, a multivariate analysis is made.

In the univariate pass (statements 511 - 600), the data are first checked for omitted data (-999). If missing data are found, the observation is ignored. PMATX stores on NW2 the following arrays: NN which consists of the incidence matrices, SUBT which is the array of cell totals, DSS which is the array of sums of squares in each cell, and DSQU which is the vector of the sum of squares of all observations for each variable, the latter being in double precision.

In the multivariate pass (statements 510 - 520), the number of variables to be used (NLUV) is first calculated by counting the nonzero elements in LUV. NLUV and NVBL are then exchanged. This exchange retains the value of NVBL so that the multivariate pass can be executed as many times as desired as if it were the first. Here, if missing data are found in any part of the record (signalled by ISET(13)), the entire record is eliminated. Also, if the LUV element for a variable is 0, the data for this variable are ignored. Once each record has been

processed through statement 505, the LUV vector is restored to its original values so that correct values will be obtained in all records.

For this multivariate pass, PMATX also stores, on NW2, DSSCP which is a matrix of sums of squares and cross products.

MAINC

For each response variable, the arrays DSSCP, NN, DSS, SUBT, and the vector DSQU are read from NW2. Because NN, DSS, and SUBT are read when needed, the storage areas are equivalenced thus reducing the size of the subroutine. An incidence matrix NN1 is constructed from NN; a matrix of sums of squares SS is constructed from DSS; a matrix of subtotals SUB is constructed from SUBT; and a variable DSQV which is the sum of squares of all observations is produced from the vector DSQU. MAINC then calls ANOT which performs the univariate analysis of each variable. After ANOT returns control, intermediate results once again are stored on NW2.

ANOT

This subroutine is called from MAINC once for each response variable. ANOT performs the univariate analysis by the use of adjusted normal equations.

If the number of rows is greater than the number of columns, exchanges are made in NR and NC, NX (incidence matrix), SQRX (cell sum of squares matrix), SUBX (cell totals matrix), and the variable IFLAG is set to 1. If any rows or columns are empty, a compacting routine then eliminates the rows or columns from NX, SQRX, and SUBX. Calculations of

the number of observations in each row (NJDOT), unadjusted row totals (R), number of observations in each column (NDOTJ), unadjusted column totals (C), grand total (G), total number of observations (NN), grand mean (GM), corrected sum of squares for total (SSTO), sum of squares for subtotals (SSB), sum of squares for error (SSE) are completed. In loop 60 the matrix CX of the "adjusted normal equations" and vector Q (vector of "adjusted row totals") are calculated. Loop 288 calculates the adjusted column totals (QB). The adjusted normal equations and adjusted row totals are reduced by one so the EQSYM inverts an (r-1)x(r-1) matrix. Estimates of row effects (RE) and column effects (CE) are both obtained by statement 216. Loop 92 obtains the cell standard deviations.

The analysis of variance begins with statement 215. Sums of squares, mean squares, F-ratios, and estimates of adjusted means (ordered) are all completed by statement 246.

The table for each variable which includes cell means, the number of observations in each cell, the standard deviation for each cell, unadjusted row and column means, estimates of row and column effects, and an analysis of variance table containing sums of squares, mean squares, degrees of freedom, F versus error, and F versus interaction is then placed on N1 and N2.

If the rows and columns were exchanged originally, they are exchanged again. ANOT then calls INTER before returning control to MAINC. ANOT returns to MAINC the estimates of row effects (RE), estimates of column effects (CE), the adjusted row totals (Q), and the adjusted column totals (QB). MAINC then stores these results on NW2.

A description of the algorithms employed is given in Section 3.1.

EQSYM

This subroutine solves the adjusted normal equations by the inversion of an (r-1)x(r-1) matrix where r is the number of levels of the factor with the least number of levels.

INTER

This subroutine is called from ANOT just before control is returned to MAINC. It displays a message to the user indicating the variables on which analysis has been completed. The user then has the choice of pressing program function key 1 to continue with calculations or key 2 to stop calculations. If key 2 is depressed, the variable NVBL (number of response variables) is reset to the variable IV (the number of the last response variable on which analysis has been completed). Control is then returned to ANOT.

OUTPUT

This subroutine is to display to the user the direct access units 16 and 17 on which all output was placed. Since a normal printout page is 131 characters wide and the maximum number of characters on the screen is 74 characters, unit 16 contains the left side of a page and statements 15 - 17 control the display while unit 17 contains the right side of a page and statements 25 - 27 control its display.

The user may see his output by using three program function keys: key 1 alternates the portion of the current page, key 2 increments the page number, and key 3 decrements the page number.

When the user finishes with his univariate results he determines where control is passed by the use of the program function keys: if he wants to continue to his multivariate results, he presses key 4 which passes control to subroutine DELETE; if he wants to see and edit his data, he presses key 5 which passes control to the 1001 statement of the INPUT subroutine; if he wants to see plots of his data, he presses key 6 which passes control to the subroutine PLOT.

When the user finishes with his multivariate results, he is asked to depress program function key 31 to terminate the program or key 4 to perform another multivariate analysis. Although the option is not mentioned on the display, the user may do exactly as he could when he completed the univariate passes; i.e., key 5 will pass control to the 1001 statement of INPUT and key 6 will pass control to PLOT.

PLOT

This subroutine allows the user to see his data of any two response variables plotted. In the general instructions, he is told to indicate combination of all levels of a factor by "0". Thus, when he gives the set of points which he wishes to see

2,2	indicates the (2,2) cell
0,4	indicates the 4th column
3,0	indicates the 3rd row
0,0	indicates all data

if the rows are factor 1. A check is made to insure that the user has requested a "legal" display; i.e., if the 4th column does not

exist for his data the user will be given an error message and asked to reenter his data. The user enters his two variable names, and once again a check is made on whether the names match those given in INPUT.

Loop 75 scans the raw data on NW1, picks out the appropriate points, and begins calculations of the means and standard deviations for the two variables. Immediately after the 75 loop, if the particular plot has one or fewer points, the user is given an error message and is asked to reenter a new set of levels. The upper and lower limits for each variable are calculated as the mean $\pm$ three sigma limits.

The plot displays the record number of the points. Thus, the user can quickly pick out which records he is seeing.

Once the user has seen the plot, control of the program depends upon his choice of the program function keys: key 1 will allow him to see additional plots, key 5 will allow him to return to the 1001 statement of INPUT to see and edit his data, and key 29 will allow him to return to the previous univariate analysis. As always, key 30 will allow the user to restart the program and key 31 will allow him to terminate the program.

DELETE

This subroutine is called from the root when the user has decided to continue with the multivariate option. Initially, the variable MULT is set to 0 to indicate the multivariate pass in future subroutines.

Each response variable name is displayed, and the user is asked to press program function key 1 to include the variable or key 2 to delete the variable. If key 1 is depressed, LUV(IK) = IK, MNLUV(IK) = IK,

and TNAM(IK) = VNAM(IK). If key 2 is depressed, LUV(IK) = 0, MNLUV(IK) = 0, TNAM(IK) = BLANK, and the name is erased from the screen. If the user is satisfied with the final list, beginning with statement 50 the TNAM array is then compressed so that it contains only the names of the response variables to be included in the multivariate analysis. Control is then returned to the root.

MAINB

This subroutine is not called until the multivariate option is entered. NW2 is backspaced one record, the incidence matrix NN1 is read, and the NW2 is rewound. DSSCP is read, and the NN, SUBT, DSS, and DSQU are all bypassed by dummy read statements. MAINB then uses the results from ANOT to build the input for GENHE which generates the H and E matrices (see Section 3.2). Once control is returned from GENHE, MAINB stores the results on NW2.

GENHE

This subroutine uses the adjusted row effect estimates, adjusted row totals, adjusted column effect estimates, adjusted column totals, the subtotal matrices, and the incidence matrix to compute the elements of the H matrices (sums of squares and products for hypotheses) and the E matrix (sums of squares and products for error).

MAINE

Here the data which will be needed by TEMAT are read from NW2. This subroutine also controls the intermediate output of results.

Before control is finally returned to the root, MAINE exchanges the values of NVBL and NLUV so that subsequent multivariate passes can have the original value of NVBL. This allows the user to use several different combinations of variables.

TEMAT

See Section 3.2.

TRI

This subroutine obtains the triangular matrix T such that TT' = A where A is a symmetric Gramian matrix. If A is singular, T will be rectangular such that the number of columns is equal to the rank of A.

FACE

This subroutine is called from TEMAT and it obtains the largest root and associated eigenvector of a symmetrix matrix.

WRIR

This subroutine is called from both MAINB and TEMAT. WRIR writes the symmetric matrices or vectors. The argument NN = 0 indicates vectors and NN = 1 indicates a symmetric matrix. Row and column numbers are replaced by names given to response variables (VNAM).

INSLD

This subroutine is called by EQSYM, MAINB, and TEMAT. INSLD obtains the inverse or conditional inverse of a Gramian matrix. It also obtains stepwise log-determinants, but if the matrix is singular these are just dummy values.

CHIX, GAMX, and YORMX

See Section 3.3.

ELGGM

This subroutine evaluates $\log_e \Gamma(x)$.

BUILD

This program is for the user of SPOOK who has voluminous data which are punched on cards. The user runs this batch program, and the needed data are stored on direct access unit 38 from where SPOOK obtains them.

Input cards must be prepared as follows:

Card 1: Title: up to 60 alphameric characters beginning in column 1

Card 2: Variable Designation and Transformations (see transformation codes under INPUT; blanks will be read as 0)

Col 1 blank

Col 2-3 number of response variables ($\leq$10)

Col 4-7 4-character name for variable 1

Col 8 transformation code for variable 1

Col 9-12 4-character name for variable 2

Col 13 transformation code for variable 2

.

.

.

Col 49-52 4-character name for variable 10

Col 53 transformation code for variable 10

Card 3: Col 5 number of variable FORMAT cards (1-5)

remaining columns may be blank or not; they will be ignored

Cards 4,5: One card for each of the two factors

Col 1 blank

Col 2-5 4-character name for factor

Col 6-8 blank

Col 9-10 number of levels ($\leq$12)

Col 11 ignored by program; may or may not be filled

Col 12-14 "end code" for level 1 (see explanation under INPUT)

Col 15 ignored

Col 16-18 "end code" for level 2

.

.

.

Col 55 ignored

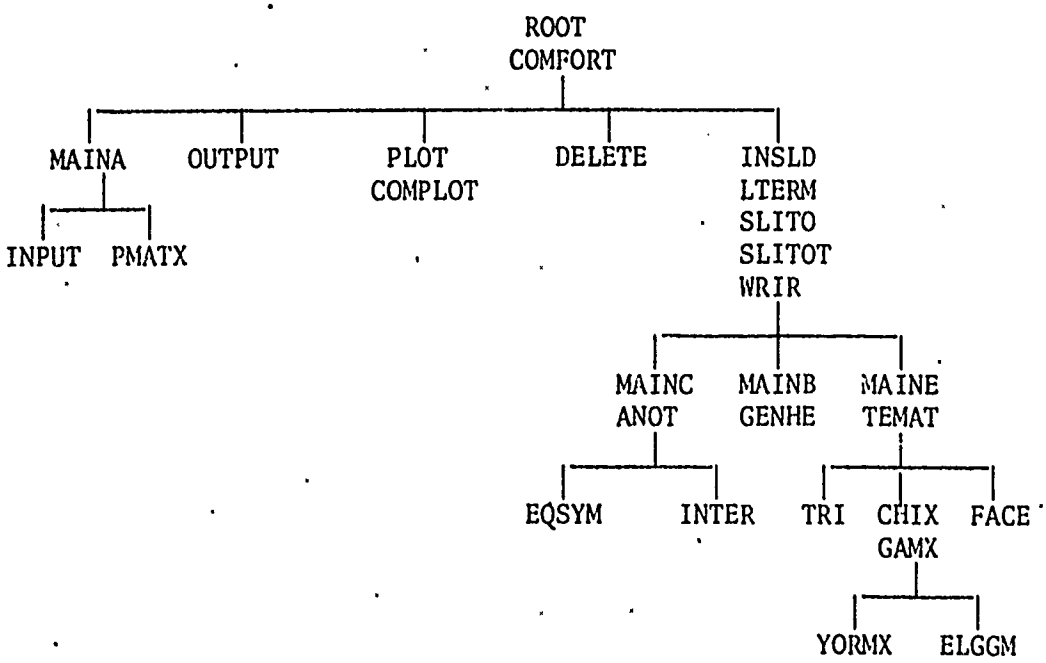
Col 56-58 "end code" for level 12

Cards 6-10: Variable FORMAT cards (number of cards must correspond to Col 5 of card 3); state the format for each record in usual FORTRAN FORMAT statement form; use all 80 columns of each card; start the first (or only) card with (, i.e., omit the word FORMAT; end the statement with); the factor levels are read first; hence, if the factor levels do not precede the variable responses, use T format.

Remaining cards are the data cards.

The output from this program is a list of the raw data as it will appear on the console when SPOOK is entered.

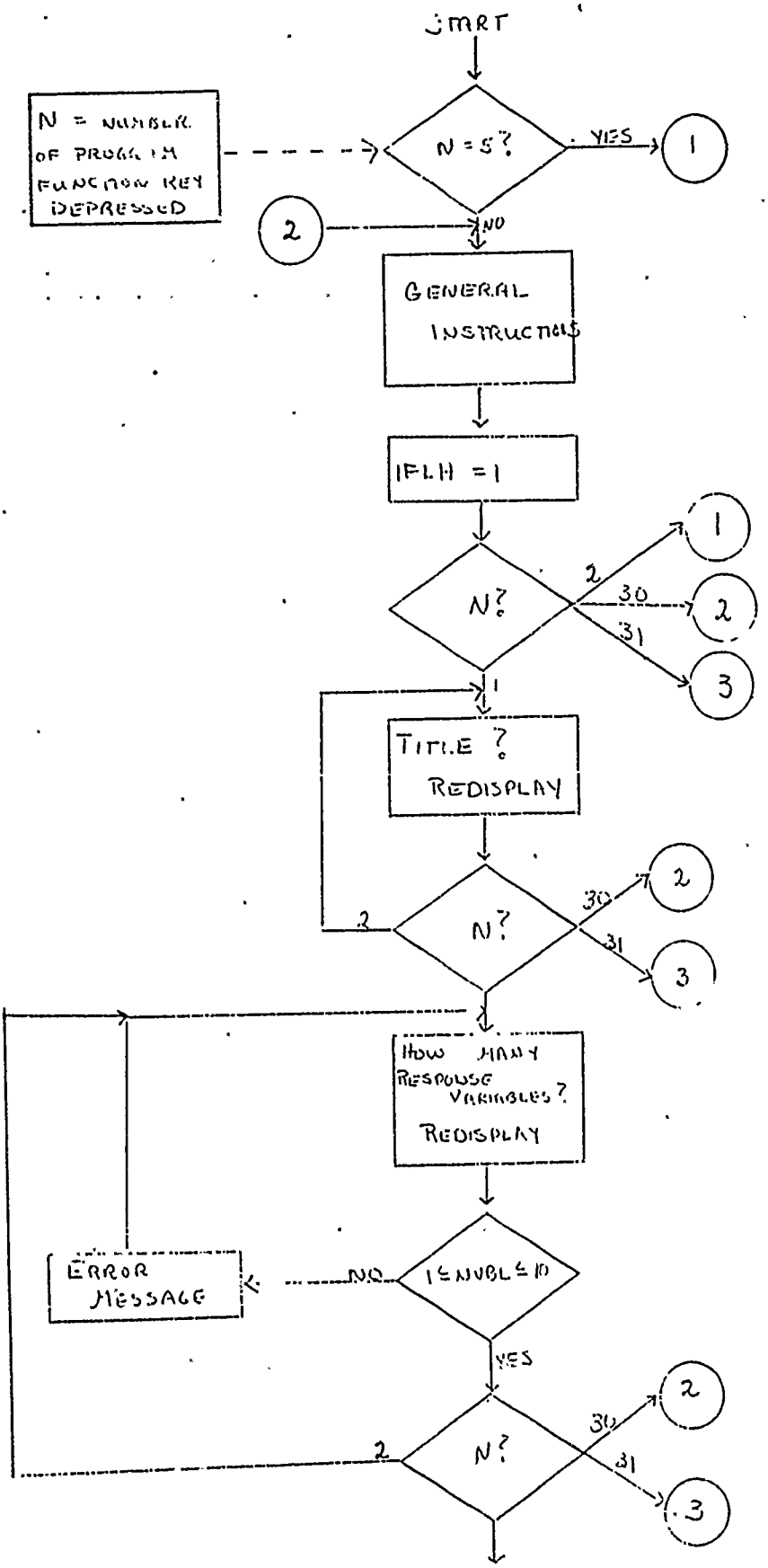
Overlay Structure

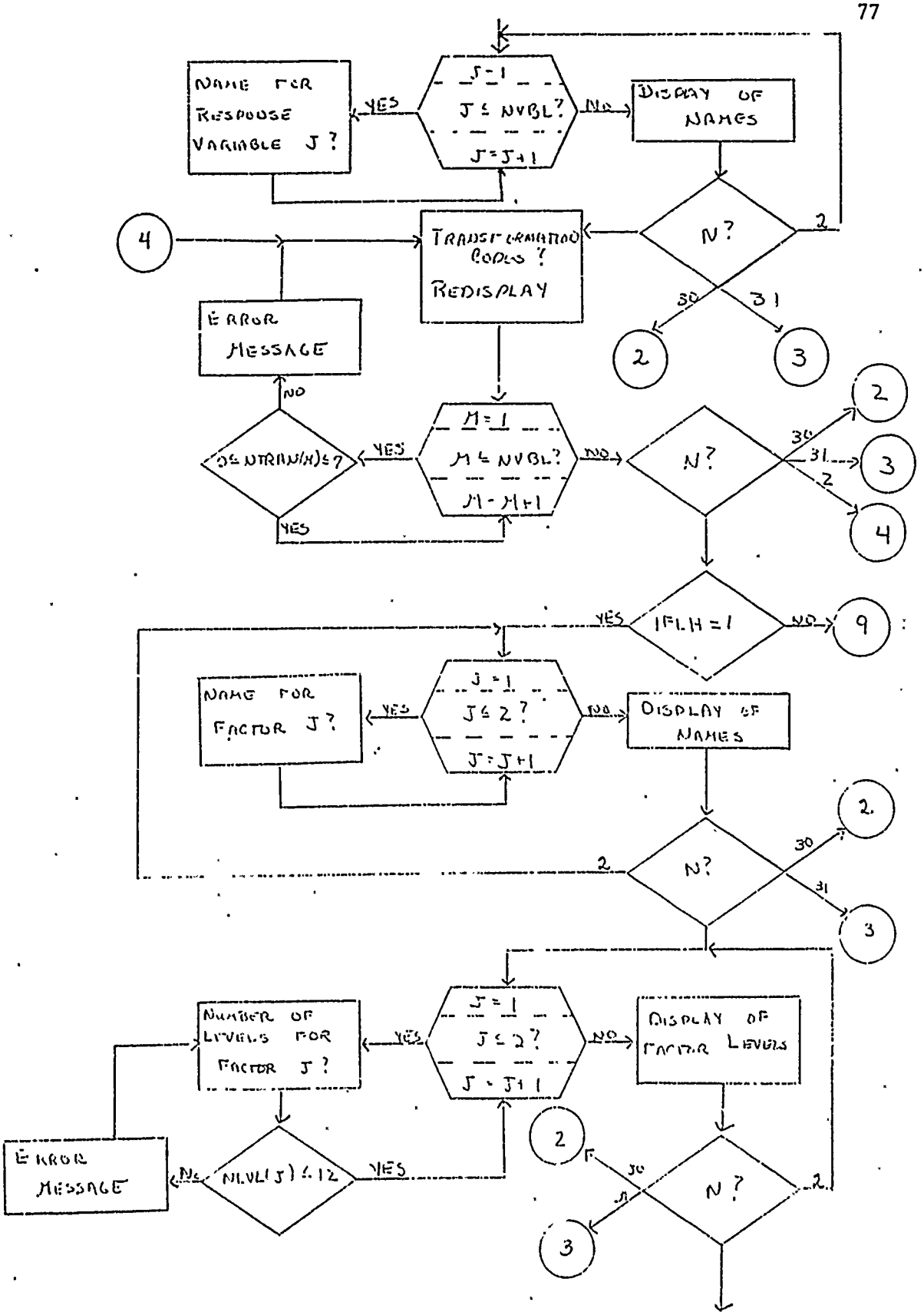


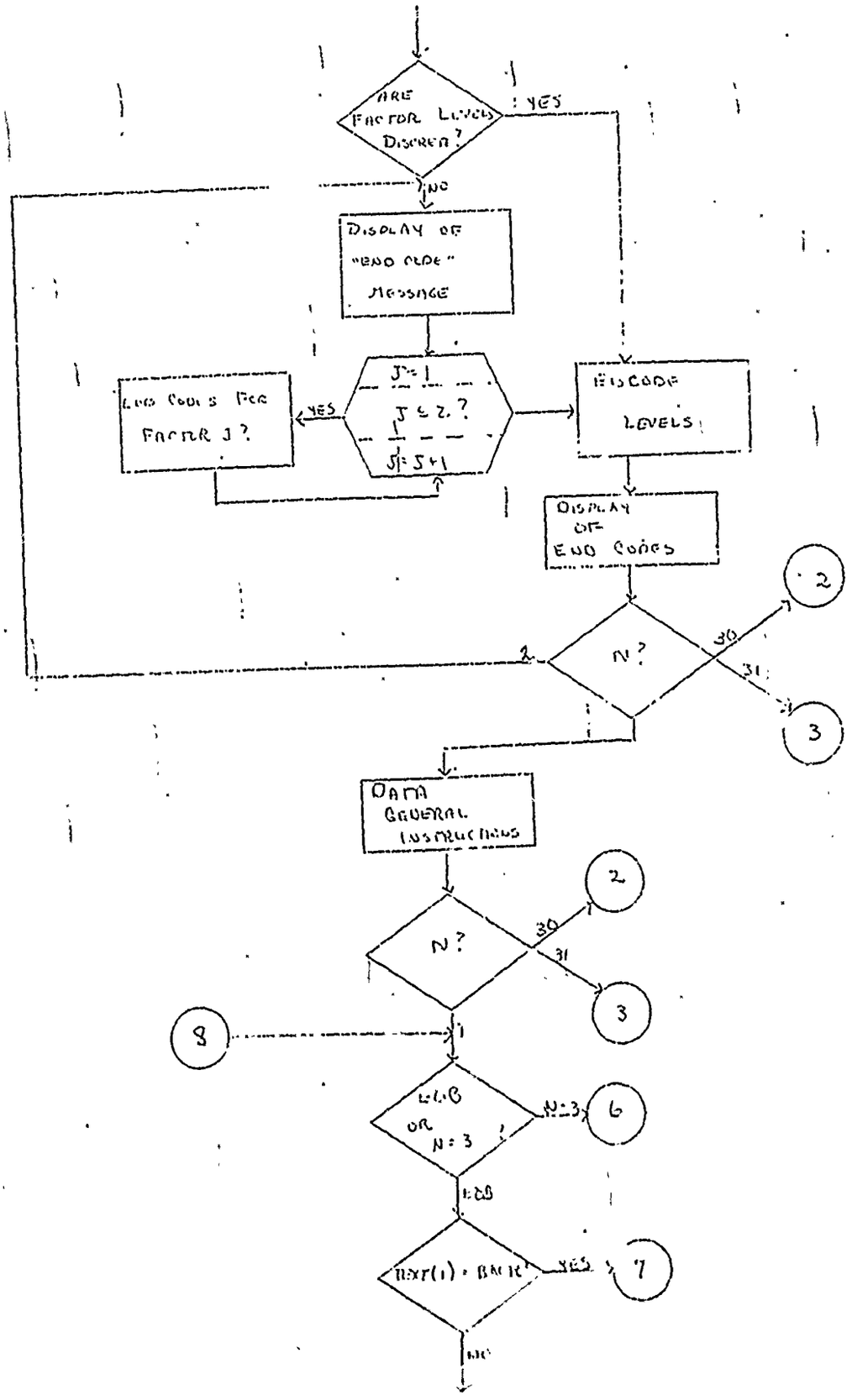
Job Control Cards for the Overlay Structure

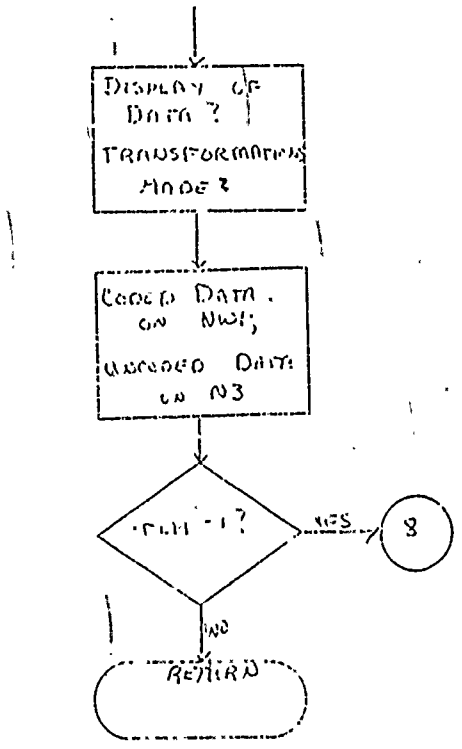
```
ENTRY MAIN
OVERLAY ONE
INSERT MAINA
OVERLAY TWO
INSERT INPUT
OVERLAY TWO
INSERT PMATX
OVERLAY ONE
INSERT OUTPUT
OVERLAY ONE
INSERT PLOT,COMPLOT
OVERLAY ONE
INSERT DELETE
OVERLAY ONE
INSERT INSLD,LTERM,SLITO,SLITOT,WRIR
OVERLAY TWO
INSERT MAINC,ANOT
OVERLAY THREE
INSERT EQSYM
OVERLAY THREE
INSERT INTER
OVERLAY TWO
INSERT MAINB,GENIE
OVERLAY TWO
```

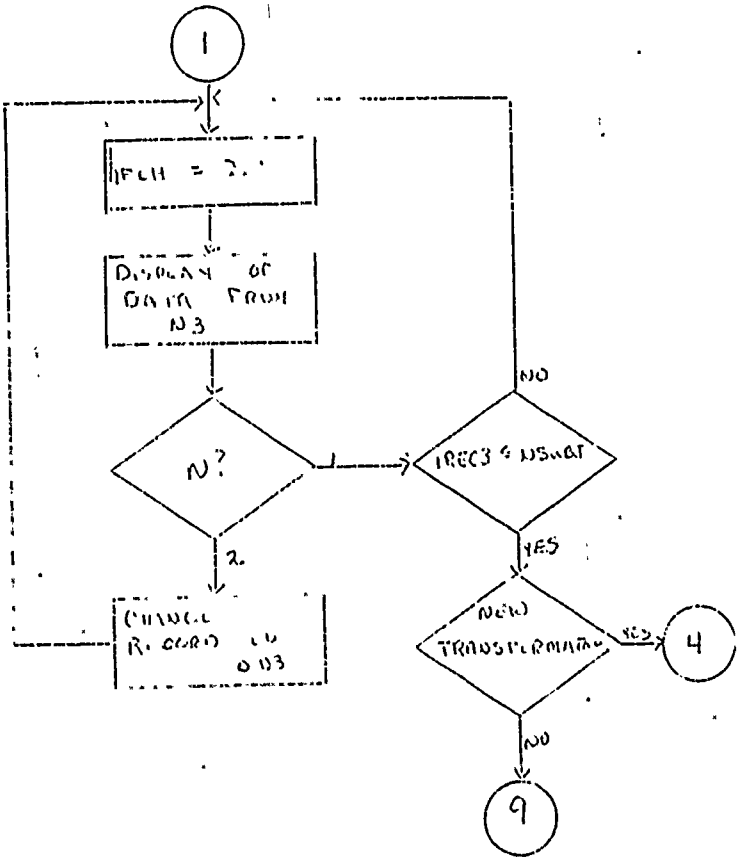
```
INSERT MAINE,TEMAT
OVERLAY THREE
INSERT TRI
OVERLAY THREE
INSERT FACE
OVERLAY THREE
INSERT CHIX,GAMX
OVERLAY FOUR
INSERT YORMX
OVERLAY FOUR
INSERT ELGGM
```

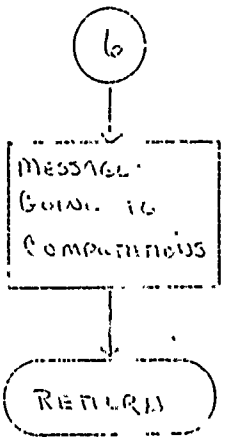

START
N = NUMBER OF PROGRAM FUNCTION KEY DEPRESSED
N = 5 ?
YES
1
2
NO
GENERAL INSTRUCTIONS
IFLH = 1
N ?
2
30
31
1
2
3
1
TITLE ? REDISPLAY
N ?
2
30
31
2
3
HOW MANY RESPONSE VARIABLES ? REDISPLAY
ERROR MESSAGE
NO
IS NUMBER ID
YES
N ?
2
30
31
2
3

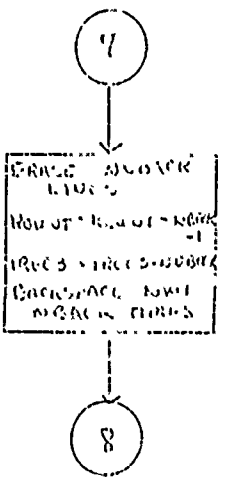

J=1
J ≤ NVBL?
J=J+1
YES
NO
NAME FOR RESPONSE VARIABLE J?
DISPLAY OF NAMES
N?
2
30
31
2
3
4
TRANSFORMATION CODES? REDISPLAY
ERROR MESSAGE
NO
DESTRAN(K)≤7
YES
M=1
M ≤ NVBL?
M=M+1
YES
NO
N?
30
31
2
2
3
4
IFLH=1
YES
NO
9
J=1
J≤2?
J=J+1
YES
NO
NAME FOR FACTOR J?
DISPLAY OF NAMES
N?
2
30
31
2.
3
J=1
J≤2?
J=J+1
YES
NO
NUMBER OF LEVELS FOR FACTOR J?
DISPLAY OF FACTOR LEVELS
NLVL(J)≤12
NO
YES
ERROR MESSAGE
N?
30
2
2
3


ARE FACTOR LEVELS DISCRETE?
YES
NO
DISPLAY OF "END CODE" MESSAGE
J=1
J ≤ 2 ?
J=J+1
YES
END CODES FOR FACTOR J ?
ENCODE LEVELS
DISPLAY OF END CODES
N ?
30
31
2
3
DATA GENERAL INSTRUCTIONS
N ?
30
31
2
3
8
1
L=0 OR N=3 ?
N=3
6
L=0
NEXT(1) = BACK
YES
7
NO


DISPLAY OF DATA ?
TRANSFORMATION MODE ?
CODED DATA ON NW1; DECODED DATA ON N3
IFCH = 1 ?
YES
8
NO
RETURN


1
IFCH = 2
DISPLAY OF DATA FROM N3
N ?
NO
IREC3 < NSMAT
YES
2
CHANGE RECORD ON N3
NEW TRANSFORMATION
YES
4
NO
9





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[3] Graybill, Franklin A., An Introduction to Linear Statistical Models, Vol. I, New York, McGraw-Hill Book Company, Inc., 1961.

[4] Penn, Lucius Wright, "An On-Line Statistical Computer System for Lay Usage", 2 Vol., Technical Report #68, University of Georgia, Department of Statistics, Athens, Georgia, May 1971.

[5] Swartz, Robert, "A Conversational Unit for Hierarchical Discriminant Analysis", Technical Report #66, University of Georgia, Department of Statistics, Athens, Georgia, April 1971

APPENDIX

COMPUTER LISTINGS

```
FORTRAN IV G LEVEL 19          MAIN          DATE = 71253          13/23/04

                C
                C
                C     THIS PROGRAM -- BUILD -- IS DESIGNED TO ALLOW THE USER
                C     OF  SPOOK  TO ENTER HIS DATA THRU BATCH MODE.
                C     THE DATA IS STORED ON DIRECT ACCESS UNIT 38
                C     FROM WHERE SPOOK OBTAINS IT.
                C
                C
0001                  DIMENSION TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),LEVEL(2,12),
                     1NTRAN(10),ISET(2),FMT(100),X(10)
0002                  DEFINE FILE 38(510,80,L,IREC3)
0003                  N3=38
0004                  READ(5,25)(TTL(I),I=1,15)
0005                  READ(5,26) NVBL,(VNAM(I),NTRAN(I),I=1,10)
0006                103 READ(5,27)NFMT
0007                  DO 100 J=1,2
0008                  READ(5,28)FNAM(J),NNN,(NEND(J,I),I=1,NNN)
0009                100 NLVL(J)=NNN
0010                  DO 844 K=1,2
0011                  JJ=NLVL(K)
0012                  IF(NEND(K,JJ)) 999,999,844
0013                999  CONTINUE
0014                  DO 998 LMN=1,JJ
0015                  NEND(K,LMN)=LMN
0016                998 CONTINUE
0017                844 CONTINUE
0018                  NFMT=NFMT*20
0019                  READ(5,29)(FMT(I),I=1,NFMT)
0020                  IREC3=502
0021                  WRITE(N3'IREC3)TTL,VNAM,FNAM,NLVL,NEND,LEVEL,NTRAN,NVBL
0022                  IREC3=1
0023                  WRITE(6,583)(FNAM(I),I=1,2),(VNAM(I),I=1,5)
0024                  WRITE(N3'IREC3,483)(FNAM(I),I=1,2),(VNAM(I),I=1,5)
0025                  IF(NVBL.GT.5)WRITE(N3'IREC3,484)(VNAM(I),I=6,10)
0026                  IF(NVBL.GT.5) WRITE(6,584)(VNAM(I),I=6,10)
0027                  NSUBJ=0
0028                200 READ(5,FMT,END=201)(ISET(I),I=1,2),(X(K),K=1,NVBL)
0029                  NSUBJ=NSUBJ+1
0030                  WRITE(N3'IREC3,396)NSUBJ,ISET(1),ISET(2),(X(KQ),KQ=1,NVBL)
0031                  WRITE(6,496)       NSUBJ,ISET(1),ISET(2),(X(KQ),KQ=1,NVBL)
0032                  GO TO 200
0033                201 IREC3=510
0034                  WRITE(N3'IREC3)NSUBJ
0035                  STOP
0036                 25 FORMAT(15A4)
0037                 26 FORMAT(I3,10(A4,I1))
0038                 27 FORMAT(4X,I1)
0039                 28 FORMAT(1X,A4,2X,I3,12(1X,I3))
0040                 29 FORMAT(20A4)
0041                396 FORMAT(3I3,1P5E12.3/9X,1P5E12.3)
0042                483  FORMAT(4X,2A4,5(4X,A4,4X))
0043                484 FORMAT(12X,5(4X,A4,4X))
0044                496 FORMAT(1H0,3I3,1P5E12.3/1H0,9X,1P5E12.3)
0045                583 FORMAT(1H1,4X,2A4,5(4X,A4,4X))
0046                584 FORMAT(1H0,12X,5(4X,A4,4X))
0047                  END
```

```
FORTRAN IV G LEVEL  19                  MAIN                DATE = 71253        13/24/17

0001                  COMMON N,IOVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
                     1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NPACT,NG12,MULT,
                     2NSUBJ,NLUV ,NN1,NN2,NT,ISEG,NI2,NJ2,KOUNT,NDIAG,IREC1,IREC2,IREC3
                     3,NTRAN(10),TNAM(10),LUV(10),RNLUV(10)
0002                  DEFINE FILE 16(1980,80,E,IREC1),17(1980,80,E,IREC2),
                     138(510,80,E,IREC3)
0003                  MULT=1
0004                1 CALL MAINA
0005                  IF(N.EQ.6)GO TO 5
0006                  IF(N.EQ.2)GO TO 3
0007                  CALL MAINC
0008                  IF(N.EQ.30)GO TO 1
0009                  IF(MULT.EQ.0)GO TO 7
0010                3 CALL OUTPUT
0011                  IF(N.EQ.5.OR.N.EQ.30)GO TO 1
0012                  IF(N.EQ.4)GO TO 4
0013                  IF(N.EQ.6)GO TO 5
0014                5 CALL PLOT
0015                  IF(N.EQ.2)GO TO 3
0016                  IF(N.EQ.30.OR.N.EQ.5)GO TO 1
0017                4 CALL DELETE
0018                  IF(N.EQ.30)MULT=1
0019                  GO TO 1
0020                7 CALL MAINB
0021                  CALL MAINE
0022                  GO TO 3
0023                9 STOP
0024                  END
```

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FORTRAN IV G LEVEL  19          MAINA           DATE = 71253      13/24/17

0001              SUBROUTINE MAINA
0002              COMMON N,IOVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
                 1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NG12,NULT,
                 2NSUBJ,NLUV ,NN1,NN2,NT,ISEQ,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC3
                 3,NTRAN(10),TNAM(10),LUV(10),MNLUV(10)
0003               NI=1
0004               NJ=2
0005               IF(NULT.EQ.0.AND.N.NE.5)GO TO 902
0006               NN1 = 11
0007               NN2 = 12
0008          950  ISEQ = 0
0009               IFAC=0
0010               CALL INPUT
0011               IF(N.EQ.6.OR.N.EQ.29)GO TO 99
0012           902 CALL PMATX(NI,NJ)
0013           110 NIZ = NI
0014               NJZ = NJ
0015            99 RETURN
0016               END
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FORTRAN IV G LEVEL  19                  INPUT                DATE = 71253          13/24/17

0001                  SUBROUTINE INPUT
0002                  EXTERNAL PRINT,LGBINT
0003                  COMMON N,ICVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
                     1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NG12,MULT,
                     2NSUBJ,NLUV ,NM1,NM2,NT,ISEG,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC
                     3,NTRAN(10),TMAP(10),LUV(10),NNLUV(10)
0004                  DIMENSION SETUP(13),          ISET(13),TEXT(15),X(10),TEXT2(18),
                     1TEXT3(20)
0005                  EQUIVALENCE (SETUP(1),ISET(1)), (TEXT2(1),TEXT3(1))
0006                  DOUBLE PRECISION GNP,DN(12)
0007                  DATA CSIZE/'B'/
0008                  DATA BLANK/'    '/
0009                  DATA BACK/'BACK'/
0010                  DATA CROP/'CROP'/
0011                  CALL GRINIT(CSIZE)
0012                  CALL GCECB(ECBIAT)
0013                  NC2=72
0014                  MASK1=1610612739
0015                  MASK2=1073741827
0016                  MASK3=268435459
0017                  MASK4=1644167175
0018                  MASK5=536870915
0019                  N3=38
0020                  NT=12
0021                  NC=66
0022                  NFAC1=2
0023                  NG12=3
0024                  NDIAG=14
0025                  NOUR=4
0026                  COIL=-999.
0027           371    FORMAT(18A4)
0028                  IF(N.EQ.5)GO TO 1001
0029                  CALL GCPEK(MASK1,PRINT)
0030                  REWIND NM1
0031                  REWIND NT
0032           211    FORMAT(15A4)
0033                  IFLG=1
                  C
                  C
0034                  NSTEP=1
0035             203  CALL GERAS(100)
0036                  CALL GROPLY('                    ',20,6400)
0037                  CALL GROPLY('                    ',20,6400)
0038                  CALL GROPLY('THIS PROGRAM IS DESIGNED TO PERFORM AN ANALYSIS OF IR
                     1REGULAR DATA.',66,6400)
0039                  CALL GROPLY('YOU MAY HAVE A MAXIMUM OF 10 RESPONSE VARIABLES AND A
                     2 MAXIMUM OF',64,6400)
0040                  CALL GROPLY('2 FACTORS.  YOUR DESIGN MAY BE QUITE UNBALANCED, AND
                     3WHOLE CELLS',64,6400)
0041                  CALL GROPLY('MAY BE MISSING.  TRANSFORMATIONS CAN BE MADE.  FOR EA
                     4CH PAIR OF',63,6400)
0042                  CALL GROPLY('FACTORS, AN ANALYSIS OF VARIANCE IS PERFORMED FOR EAC
                     5H RESPONSE',63,6400)
0043                  CALL GROPLY('VARIABLE, SEPARATELY.  ONCE YOU SEE THESE UNIVARIATE
                     1ANALYSES YOU',65,6400)
0044                  CALL GROPLY('WILL BE GIVEN THE OPPORTUNITY TO SEE PLOTS OF YOUR DA
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FORTRAN IV G LEVEL 19                INPUT              DATE = 71253          13/24/17

     1TA AND THE',63,&400)
0045      CALL GRDPLY('RAW DATA AGAIN.  THUS, YOU WILL BE ABLE TO EDIT YOUR
     1DATA AND RUN',65,&400)
0046      CALL GRDPLY('THE ANALYSES AGAIN.',19,&400)
0047      CALL GRDPLY('                    ',20,&400)
0048      CALL GRDPLY('TO BEGIN YOU MUST ANSWER QUESTIONS BY USING THE TYPEW
     1RITER',58,&400)
0049      CALL GRDPLY('KEYBOARD DIRECTLY IN FRONT OF YOU.  TO SIGNAL YOUR CO
     1MPLETION',61,&400)
0050      CALL GRDPLY('OF QUESTIONS, FIRST DEPRESS THE "ALT" KEY, AND WHILE
     1HOLDING IT',63,&400)
0051      CALL GRDPLY('DOWN, DEPRESS THE "5" KEY.  THIS SEQUENCE WILL LEAV
     1E',55,&400)
0052      CALL GRDPLY('REFERRED TO AS "EOB".  ONCE YOU ANSWER QUESTIONS, THE
     1 ANSWERS',61,&400)
0053      CALL GRDPLY('WILL BE DISPLAYED BACK TO YOU.  IF YOU ARE NOT SATISF
     1IED, PRESS',63,&400)
0054      CALL GRDPLY('KEY 2 TO REENTER DATA;  OTHERWISE, THE PROGRAM WILL C
     1ONTINUE ',61,&400)
0055      CALL GRDPLY('BY YOUR PRESSING ANY KEY.',25,&400)
0056      CALL GRDPLY(' ',1,&400)
0057      CALL GRDPLY('AT ANY TIME YOU MAY RESTART BY PRESSING KEY 3, OR TER
     1MINATE BY',62,&400)
0058      CALL GRDPLY('PRESSING KEY 31.',16,&400)
0059      CALL GRDPLY('                    ',20,&400)
0060      CALL GRDPLY(' ',1,&400)
0061      CALL GRDPLY('CAUTION:  DO NOT TRY TO SPEED UP THE PROGRAM BY ANSWE
     1RING',57,&400)
0062      CALL GRDPLY('QUESTIONS BEFORE THEY ARE ASKED.  THIS WILL ONLY CREA
     1TE PROBLEMS.',65,&400)
0063      CALL GRDPLY(' ',1,&400)
0064      CALL GRDPLY(' ',1,&400)
0065      CALL GRDPLY('IF YOU HAVE PREVIOUSLY USED THIS PROGRAM OR ENTERED Y
     1OUR DATA',61,&400)
0066      CALL GRDPLY('THROUGH BATCH MODE, PRESS KEY 2 TO SEE YOUR DATA.',49
     1,&400)
0067      CALL GRDPLY(' ',1,&400)
0068      CALL GRDPLY('PRESS KEY 1 TO PROCEED.',23,&400)
0069  205 CALL GWAIT
0070      IF(N .EQ. 30) GO TO 205
0071      IF (N.EQ.31) GO TO 210
0072      IF(N.EQ.2)GO TO 1..1
0073      IF (N .EQ. 1) GO TO 206
0074      GO TO 205
C
0075    206 CALL GERAS(100)
0076      NSTEP=2
0077      CALL GRDPLY('                    ',20,&400)
0078      CALL GRDPLY('                    ',20,&400)
0079      CALL GRDPLY('IF YOU DESIRE TO HAVE A TITLE TO HEAD YOUR OUTPUT, EN
     1TER IT NOW.',64,&400)
0080      CALL GRDPLY('IF YOU DO NOT DESIRE A TITLE, LEAVE THE RESPONSE AS
     2 BLANK.',56,&400)
0081    811 CALL GWAIT
0082      IF(ITYPE.NE.3)GO TO 402
0083    212 CALL GRRPLY(TIL,NC)
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FORTRAN IV G LEVEL  19                  INPUT              DATE = 71253          13/24/17

0084            CALL GRDPLY('                          ',20,&400)
0085            CALL GRDPLY('YOUR TITLE IS',13,&400)
0086          234 CALL GRDPLY(TTL,NC,&400)
0087          214 CALL GWAIT
0088            IF(N.EQ.2) GO TO 212
0089            IF (N.EQ.30) GO TO 203
0090            IF (N.EQ.31) GO TO 210
              C
0091          213 CALL GERAS(100)
0092            NSTEP=3
0093            CALL GRDPLY('                          ',20,&400)
0094            CALL GRDPLY('                          ',20,&400)
0095          208  CALL GRDPLY('HOW MANY RESPONSE VARIABLES DO YOU HAVE?',40,&400)
0096          812 CALL GWAIT
0097            IF(ITYPE.NE.3)GO TO 402
0098            CALL XBLANK(TEXT,NC)
0099          297  CALL GRRPLY(TEXT,NC)
0100            INDEX=0
0101            CALL INX(TEXT,INDEX,NC,DNP,&401)
0102            NVBL=DNP+.01
0103             WRITE(NOUM,150)NVBL
0104          150 FORMAT('YOU HAVE',I3,'  RESPONSE VARIABLES.',28X)
0105            CALL FETCH(TEXT2,NCF,&400)
0106            CALL GRDPLY('                          ',20,&400)
0107            CALL GRDPLY(TEXT2,NCF,&400)
0108            IF ( 1 .LE. NVBL .AND. NVBL .LE.10) GO TO 204
0109            CALL GRDPLY('                          ',20,&400)
0110            CALL GRDPLY('THE NUMBER OF RESPONSE VARIABLES MUST BE AT LEAST 1 A
               1ND NO',58,&400)
0111            CALL GRDPLY('GREATER THAN 10.  PLEASE REENTER.',33,&400)
0112             GO TO 812
0113          204 CALL GWAIT
0114            IF(N.EQ.30) GO TO 203
0115            IF (N.EQ.31) GO TO 210
0116            IF (N.EQ.2) GO TO 213
              C
0117          201  CALL GERAS(100)
0118            NSTEP=4
0119            DO 215 J=1,NVBL
0120          217 WRITE(NT,216)J
0121          216  FORMAT('ENTER A FOUR LETTER NAME FOR RESPONSE VARIABLE',13,11X)
0122            BACKSPACE NT
0123            READ(NT,211)TEXT
0124            CALL GRDPLY('                          ',20,&400)
0125            CALL GRDPLY(TEXT,NC,&400)
0126          803 CALL GWAIT
0127            IF(ITYPE.NE.3)GO TO 402
0128            CALL GRRPLY(TEXT,NC)
0129            CALL GERAS(2)
0130          215 VNAM(J) = TEXT(1)
0131            IF (NVBL.EQ.10) GO TO 157
0132            IA=NVBL+1
0133            DO 153 I=IA,10
0134          153 VNAM(I)=BLANK
0135          157 WRITE(NOUM,155)(VNAM(I),I=1,10)
0136          155 FORMAT(10(2X,A4))
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FORTRAN IV G LEVEL  19                  INPUT                DATE = 71253        13/24/17

0137                CALL FETCH(TEXT2,NCF,&400)
0138                CALL GRDPLY('                              ',20,&400)
0139                CALL GRDPLY('                              ',20,&400)
0140                CALL GRDPLY('YOUR NAMES ARE',14,&400)
0141                CALL GRDPLY(TEXT2,NCF,&400)
0142             160 CALL GWAIT
0143                 IF (N.EQ.30) GO TO 203
0144                 IF (N.EQ.31) GO TO 210
0145                 IF (N.EQ.2) GO TO 201
                  C
0146             224 CALL GERAS(100)
0147                 NSTEP=5
0148                 CALL GRDPLY('                              ',20,&400)
0149                *CALL GRDPLY('FOR EACH RESPONSE VARIABLE ENTER A TRANSFORMATION COD
                    1E FROM THE',63,&400)
0150                 CALL GRDPLY('FOLLOWING LIST:',15,&400)
0151                 CALL GRDPLY('                              ',20,&400)
0152                 CALL GRDPLY('   CODE      TRANSFORMATION',25,&400)
0153                 CALL GRDPLY('    0,1      NO TRANSFORMATION',29,&400)
0154                 CALL GRDPLY('      2      LOGE(X)   (X>0)',27,&400)
0155                 CALL GRDPLY('      3      LOGE(1+X)   (X>-1)',30,&400)
0156                 CALL GRDPLY('      4      SQRT(X)   (X>=0)',28,&400)
0157                 CALL GRDPLY('      5      1/X   (X>0)',23,&400)
0158                 CALL GRDPLY('      6      ARCSIN(2X-1)   (0<X<1)',34,&400)
0159                 CALL GRDPLY('             VARIANCE-STABILIZING TRANSFORMATION FOR P
                    1ROPORTIONS',63,&400)
0160                 CALL GRDPLY('      7      AVAILABLE (NOW: NO TRANSFORMATION)',46,
                    1&400)
0161                 CALL GRDPLY('                              ',20,&400)
0162                 CALL GRDPLY('SEPARATE ALL ANSWERS BY COMMAS.',31,&400)
0163                 CALL GRDPLY('                              ',20,&400)
0164             804 CALL GWAIT
0165                 IF(ITYPE.NE.3)GO TO 402
0166             290 CALL GRRPLY(TEXT,NC)
0167                *CALL INK(TEXT,NC,5,IER,DN(1),DN(2),DN(3),DN(4),DN(5))
0168                 IF(IER.NE.0)GO TO 401
0169                 IF(NVBL.LE.5)GO TO 219
0170                 CALL INK(TEXT,NC,5,IER,DN(6),DN(7),DN(8),DN(9),DN(10))
0171                 IF(IER.NE.0)GO TO 401
0172             219 CONTINUE
0173                 DO 173 IJK=1,10
0174             173 NTRAN(IJK)=DN(IJK)
0175                 WRITE(NOUM,55)(VNAM(I),I=1,10)
0176                 CALL FETCH(TEXT2,NCF,&400)
0177                 CALL GRDPLY(TEXT2,NCF,&400)
0178             174 WRITE(NOUM,175)(NTRAN(M),M=1,NVBL)
0179             175 FORMAT(10(I4,2X))
0180                 CALL FETCH(TEXT2,NCF,&400)
0181                 CALL GRDPLY(TEXT2,NCF,&400)
0182                 DO 298 M=1,NVBL
0183                 IF (NTRAN(M).GE.0 .AND. NTRAN(M).LE.7) GO TO 298
0184                 WRITE(NT,299)NTRAN(M)
0185             299 FORMAT('A TRANSFORMATION OF',I3,' IS ILLEGAL.  REENTER ALL DATA.',
                    17X)
0186                 BACKSPACE NT
0187                 READ(NT,211)TEXT
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FORTRAN IV G LEVEL  19                  INPUT              DATE = 71253          13/24/17

0188                CALL GRDPLY(TEXT,NC,&400)
0189                CALL GRDPLY('                          ',20,&400)
0190                GO TO 804
0191           298  CONTINUE
0192           169  CALL GWAIT
0193                IF (N.EQ.2) GO TO 224
0194                IF(N.EQ.30) GO TO 203
0195                IF (N.EQ.31) GO TO 210
0196           237  GO TO (225,&60),IFLH
                C
0197           225  CALL GERAS(100)
0198                NSTEP=7
0199                DO 226 J=1,2
0200           229  WRITE(NOUN,227)J
0201           227  FORMAT('ENTER A FOUR LETTER NAME FOR FACTOR',I3,22X)
0202                CALL FETCH(TEXT2,NCF,&400)
0203                CALL GRDPLY('                          ',20,&400)
0204                CALL GRDPLY(TEXT2,NCF,&400)
0205           805  CALL GWAIT
0206                IF(ITYPE.NE.3)GO TO 402
0207                CALL GRRPLY(TEXT,NC)
0208                CALL GERAS(2)
0209           226  FNAM(J)=TEXT(1)
0210                WRITE(NOUN,326)FNAM(1),FNAM(2)
0211           326  FORMAT(2(2X,A4),40X)
0212                CALL FETCH(TEXT2,NCF,&400)
0213                CALL GRDPLY('                          ',20,&400)
0214                CALL GRDPLY('                          ',20,&400)
0215                CALL GRDPLY('YOUR NAMES ARE',14,&400)
0216                CALL GRDPLY(TEXT2,NCF,&400)
0217           327  CALL GWAIT
0218                IF (N.EQ.30) GO TO 203
0219                IF (N.EQ.31) GO TO 210
0220                IF (N.EQ.2) GO TO 225
                C
0221           228  CALL GERAS(100)
0222                NSTEP=8
0223                CALL GRDPLY('                          ',20,&400)
0224                CALL GRDPLY('                          ',20,&400)
0225                CALL GRDPLY('YOU MAY HAVE UP TO 12 LEVELS PER FACTOR.',40,&400)
0226                CALL GRDPLY('                          ',20,&400)
0227                DO 241 J=1,2
0228           243  WRITE(NOUN,240)FNAM(J)
0229           240  FORMAT('HOW MANY LEVELS DO YOU HAVE FOR FACTOR ',A4,'?',16X)
0230                CALL FETCH(TEXT2,NCF,&400)
0231                CALL GRDPLY(TEXT2,NCF,&400)
0232           806  CALL GWAIT
0233                IF(ITYPE.NE.3)GO TO 402
0234           291  CALL GRRPLY(TEXT,NC)
0235                CALL XBLANK(TEXT,NC)
0236                INDEX=0
0237                CALL INX(TEXT,INDEX,NC,DNP,&401)
0238                NLVL(J)=DNP+.01
0239                IF (NLVL(J).LE.12) GO TO 241
0240                CALL GRDPLY('NUMBER OF LEVELS CANNOT EXCEED 12.  TRY AGAIN.',46,
                   1&400)
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FORTRAN IV G LEVEL 19          INPUT          DATE = 71253          13/24/17

0241            GO TO 806
0242          241 CONTINUE
0243            WRITE(NDUM,330)FNAM(1),NLVL(1),FNAM(2),NLVL(2)
0244          330  FORMAT('FACTOR ',A4,' HAS',I3,' LEVELS, AND FACTOR ',A4,' HAS',I3,
                1' LEVELS.',3X)
0245            CALL FETCH(TEXT2,NCF,&400)
0246            CALL GRDPLY('                    ',20,&400)
0247            CALL GRDPLY(TEXT2,NCF,&400)
0248          242  CALL GWAIT
0249            IF (N.EQ.30) GO TO 203
0250            IF (N.EQ.31) GO TO 210
0251            IF(N.EQ.2) GO TO 228
              C
0252          331 CALL GFRAS(100)
0253            DO 340 K=1,2
0254            DO 340 I=1,12
0255            NEND(K,I)=0
0256          340  CONTINUE
0257            NSTEP=9
0258            CALL GRDPLY('                    ',20,&400)
0259            CALL GRDPLY('                    ',20,&400)
0260            CALL GRDPLY('YOUR FACTORS SHOULD BE IN DISCRETE LEVELS AS 1,2,...,
               112.  BUT',61,&400)
0261            CALL GRDPLY('IF YOUR DATA IS CONTINUOUS, GROUPING CAN BE DONE FOR
               1YOU.',57,&400)
0262            CALL GRDPLY('IF YOUR LEVELS ARE ALREADY DISCRETELY DEFINED, PRESS
               1KEY 1.',59,&400)
0263            CALL GRDPLY('IF YOUR DATA IS CONTINUOUS, PRESS KEY 2.',40,&400)
0264          245 CALL GWAIT
0265            IF (N.EQ.30) GO TO 203
0266            IF (N.EQ.31) GO TO 210
0267            IF (N.EQ.1) GO TO 247
0268            IF (N.EQ.2) GO TO 246
0269            GO TO 245
              C
0270          246  CALL GFRAS(100)
0271            NSTEP=10
0272            CALL GRDPLY('                    ',20,&400)
0273            CALL GRDPLY('                    ',20,&400)
0274            CALL GRDPLY('TO GROUP THE DATA, ASSIGN EACH LEVEL OF THE FACTOR AN
               1 "END CODE"',64,&400)
0275            CALL GRDPLY('OR AN IDENTIFIER;  EG, IF ONE OF THE FACTORS IS AGE R
               1ANGING FROM',64,&400)
0276            CALL GRDPLY('5 YEARS TO 25 YEARS, WE MAY WISH TO ASSIGN AGES TO LE
               1VELS AS',60,&400)
0277            CALL GRDPLY('      5- 9 YEARS    LEVEL 1',25,&400)
0278            CALL GRDPLY('     10-14 YEARS    LEVEL 2',25,&400)
0279            CALL GRDPLY('     15-19 YEARS    LEVEL 3',25,&400)
0280            CALL GRDPLY('     20-25 YEARS    LEVEL 4',25,&400)
0281            CALL GRDPLY('THEN THE END CODE FOR LEVEL 1 WOULD BE 9, THE END COD
               1E FOR',58,&400)
0282            CALL GRDPLY('LEVEL 2 WOULD BE 14, ETC.',25,&400)
0283            CALL GRDPLY('THIS DATA WOULD BE ENTERED AS   9,14,19,25',42,&400)
0284            CALL GRDPLY('                    ',20,&400)
0285            DO 250 J=1,2
0286            NL=NLVL(J)
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FORTRAN IV G LEVEL  19              INPUT              DATE = 71253          13/24/17

0287          256 WRITE(NOUN,251)NLVL(J),FNAM(J)
0288          251  FORMAT ('WHAT ARE THE "END CODES" FOR THE',I3,' LEVELS OF FACTOR '
                 1,A4,'?',2X)
0289              CALL FETCH(TEXT2,NCF,6400)
0290              CALL GRDPLY(TEXT2,NCF,6400)
0291           807 CALL GWAIT
0292              IF(ITYPE.NE.3)GO TO 402
0293          293  CALL GRRPLY(TEXT,NC)
0294              CALL INK(TEXT,NC,8,IER,DN(1),DN(2),DN(3),DN(4),DN(5),DN(6),DN(7),
                 1DN(8))
0295              IF(IER.NE.0)GO TO 401
0296              IF(NL.LE.8)GO TO 357
0297              CALL INK(TEXT,NC,4,IER,DN(9),DN(10),DN(11),DN(12))
0298              IF(IER.NE.0)GO TO 401
0299           357 DO 252 I=1,NL
0300           252 NEND(J,I)=DN(I)
0301          250  CONTINUE
              C
0302           247 CALL GERAS(100)
0303              DO 844 K=1,NFACT
0304              JJ = NLVL(K)
0305              IF(NEND(K,JJ))  999,999,844
0306          999  CONTINUE
0307              DO 998 LMN = 1,JJ
0308              NEND(K,LMN) = LMN
0309          998   CONTINUE
0310          844  CONTINUE
0311              CALL GRDPLY('                          ',20,6400)
0312              CALL GRDPLY('                          ',20,6400)
0313              DO 350 J=1,2
0314              NL=NLVL(J)
0315              WRITE(NOUN,345)NLVL(J),FNAM(J)
0316           345 FORMAT('THE "END CODES" FOR THE',I3,' LEVELS OF FACTOR ',A4,12X)
0317              CALL FETCH(TEXT2,NCF,6400)
0318              CALL GRDPLY(TEXT2,NCF,6400)
0319           352 WRITE(NOUN,356)    (NEND(J,I),I=1,NL)
0320           356 FORMAT(12(I3,1X),12X)
0321              CALL FETCH(TEXT2,NCF,6400)
0322           350 CALL GRDPLY(TEXT2,NCF,6400)
0323           360  CALL GWAIT
0324              IF(N.EQ.30) GO TO 203
0325              IF(N.EQ.31) GO TO 210
0326              IF(N.EQ.2) GO TO 246
              C
              C
0327           285  CALL GERAS(100)
0328              CALL GCPFK(MASK2,PFINT)
0329              NSTEP=11
0330              CALL GRDPLY('                          ',20,6400)
0331              CALL GRDPLY('                          ',20,6400)
0332              CALL GRDPLY('NOW YOU MUST SUPPLY THE DATA.  YOU WILL NEED TO INDIC
                 1ATE THE',60,6400)
0333              CALL GRDPLY('LEVELS OF THE FACTORS AND THE RESPONSE OF EACH VARIAB
                 1LE.',56,6400)
0334              CALL GRDPLY('     EXAMPLE:   2,7,412,34,5',28,6400)
0335              CALL GRDPLY('     INDICATES FACTOR 1 IS AT LEVEL 2, FACTOR 2 IS AT
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FORTRAN IV G LEVEL 19          INPUT          DATE = 71253          13/24/17

     1 LEVEL 7,',62,&400)
0336  CALL GRDPLY('     THE RESPONSE FOR VARIABLE 1 IS 412, THE RESPONSE
     1 FOR',57,&400)
0337  CALL GRDPLY('     VARIABLE 2 IS 34, AND THE RESPONSE FOR VARIABLE
     13 IS 5.',60,&400)
0338  CALL GRDPLY('IF YOU WANT TO OMIT DATA ON A PARTICULAR RANDOM VARIA
     1BLE,',57,&400)
0339  CALL GRDPLY('REPLACE IT BY -999.',19,&400)
0340  CALL GRDPLY('     EXAMPLE:   2,7,412,-999,5',30,&400)
0341  CALL GRDPLY('     INDICATES THAT THE DATA FOR THE SECOND RESPONSE'
     1,52,&400)
0342  CALL GRDPLY('     VARIABLE IS OMITTED.',25,&400)
0343  CALL GRDPLY(' ',1,&400)
0344  CALL GRDPLY('WHEN YOU HAVE ENTERED ALL DATA, PRESS KEY 3.',44,&400
     1)
0345  CALL GRDPLY('                          ',20,&400)
0346  CALL GRDPLY('SHOULD YOU REALIZE YOU HAVE A MISTAKE IN YOUR DATA, T
     1YPE "BACK"',63,&400)
0347  CALL GRDPLY('AND THE NUMBER OF ENTRIES YOU WISH TO GO BACK.',46,
     1&400)
0348  CALL GRDPLY('                          ',20,&400)
0349  CALL GRDPLY('WHEN YOU ARE READY TO ENTER YOUR DATA, PRESS KEY 1.',
     151,&400)
0350  IREC3=512
0351  WRITE(N3'IREC3)TTL,VNAM,FNAM,NLVL,NEND,LEVEL,NTRAN,NVBL
0352  IREC3=1
0353  WRITE(N3'IREC3,483)BLANK,(FNAM(I),I=1,2),(VNAM(I),I=1,5)
0354   483 FORMAT(3A4,5(4X,A4,4X))
0355  KODE=0
0356  KOUNT=0
0357   269 CALL GWAIT
0358  IF (N.EQ.30) GO TO 203
0359  IF (N.EQ.31) GO TO 210
0360  IF (N.EQ.1) GO TO 482
0361  GO TO 269
      C
0362   482 CALL GERAS(100)
0363  CALL GRDPLY('                          ',20,&400)
0364  WRITE(NOUN,483)BLANK,(FNAM(I),I=1,2),(VNAM(I),I=1,5)
0365  CALL FETCH(TEXT2,NCF,&400)
0366  CALL GRDPLY(TEXT2,NCF,&400)
0367  IF(NVBL.LE.5) GO TO 485
0368  WRITE(NOUN,484)(VNAM(I),I=6,10)
0369  WRITE(N3'IREC3,484) (VNAM(I),I=6,10)
0370   484 FORMAT(12X,5(4X,A4,4X))
0371  CALL FETCH(TEXT2,NCF,&400)
0372  CALL GRDPLY(TEXT2,NCF,&400)
0373   485 CONTINUE
0374  CALL GRDPLY('                          ',20,&400)
0375  NSTEP=12
0376  CALL GCPFK(MASK3,PFINT)
0377  SETUP(13)=0.0
0378   294 KOUNT=KOUNT+1
0379   808 CALL GWAIT
0380  IF((ITYPE.EQ.1.AND.N.EQ.3)GO TO 390
0381  IF(ITYPE.NE.3)GO TO 402
```

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FORTRAN IV G LEVEL  19              INPUT          DATE = 71253        13/24/17

0382          508 CALL GRRPLY(TEXT,NC)
0383              IF(TEXT(1).EC.BACK) GO TO 380
0384              CALL INK(TEXT,NC,7,IER,DN(1),DN(2),DN(3),DN(4),DN(5),DN(6),DN(7))
0385              IF(IER.NE.0)GO TO 507
0386              IF(NVBL.LE.5)GO TO 260
0387              CALL INK(TEXT,NC,5,IER,DN(8),DN(9),DN(10),DN(11),DN(12))
0388              IF(IER.NE.0)GO TO 507
0389          260 ISET(1)=DN(1)
0390              ISET(2)=DN(2)
0391              DO 261 IZ=1,10
0392          261 X(IZ)=DN(IZ+2)
0393              IF(KCDE.NE.0) CALL GBKSP(KCDE)
0394              IF(NVBL.LT.5)WRITE(NOUN,370)KOUNT,(ISET(I),I=1,2),(X(I),I=1,NVBL)
0395              IF(NVBL.GE.5)WRITE(NOUN,370)KOUNT,(ISET(I),I=1,2),(X(I),I=1,5)
0396          370 FORMAT(I4,2(I3,1X),1P5E12.3)
0397              CALL FETCH(TEXT2,NCF,6400)
0398          374 CALL GROPLY(TEXT2,NCF,6500)
0399              IF(NVBL.LE.5) GO TO 101
0400              WRITE(NOUN,375)(X(I),I=6,NVBL)
0401          375 FORMAT(12X,5(2X,1PE10.3))
0402              CALL FETCH(TEXT2,NCF,6400)
0403          378 CALL GROPLY(TEXT2,NCF,6502)
0404          396 FORMAT(3I3,1P5E12.3/9X,1P5E12.3)
0405          101 KODE=0
0406              WRITE(N3'IREC3,396)KCUNT,(ISET(1),ISET(2),(X(KQ),KQ=1,NVBL)
                C
0407          621 DO 106 K=1,NFACT
0408              JJ=NLVL(K)
0409          107 DO 108 J=1,JJ
0410              IF(ISET(K)-NENC(K,J))109,109,108
0411          109 ISET(K)=J
0412              GO TO 106
0413          108 CONTINUE
0414              ISET(K)=JJ
0415          106 CONTINUE
0416              DO 102 K=1,NVBL
0417              IF(X(K) - CUTL) 103,10,103
0418          103 KK=NTRAN(K)+1
0419              GO TO(1,1,2,3,4,5,6,7),KK
0420          1   SETUP(K+2)=X(K)
0421              GO TO 102
0422          2   IF(X(K))10,10,11
0423             10 SETUP(K+2)=OUTL
0424              SETUP(13)=1.0
0425              GO TO 102
0426          11  SETUP(K+2)=ALOG(X(K))
0427              GO TO 102
0428          3   IF(X(K)+1.0)10,10,12
0429          12  SETUP(K+2)=ALOG(X(K)+1.0)
0430              GO TO 102
0431          4   IF(X(K))10,13,13
0432          13  SETUP(K+2)=SQRT(X(K))
0433              GO TO 102
0434          5   IF(X(K))10,10,14
0435          14  SETUP(K+2)=1.0/X(K)
0436              GO TO 102
```

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FORTRAN IV G LEVEL  19          INPUT          DATE = 71253      13/24/17

0437        6     IF(X(K)*(1.-X(K)))10,15,15
0438          15  SETUP(K+2)=ARSIN(2.*X(K)-1.)
0439              GO TO 102
0440        7     SETUP(K+2)=X(K)
            C     ***************************DUMMY SUBSCRIPTION*****************************************
0441        102   CONTINUE
0442              IREX=IREC3
0443              IREC3=510
0444              IF(IFLH.EQ.1)WRITE(N3'IREC3)KOUNT
0445              IF(IFLH.EQ.2)WRITE(N3'IREC3)NSUBJ
0446              IREC3=IREX
0447              WRITE (NW1) SETUP
0448              SETUP(13)=0.0
0449              GO TO (294,664),IFLH
            C
0450          390 CALL GERAS(1C0)
0451              NSUBJ=KOUNT-1
0452              CALL GCPFK(MASK2,PFINT)
0453              CALL GRDPLY(' ',1,&400)
0454              CALL GRDPLY(' ',1,&400)
0455              CALL GRDPLY('NOW THAT YOU HAVE ENTERED ALL OF YOUR DATA, YOU CAN P
                 1RESS KEY 1',63,&400)
0456              CALL GRDPLY('TO CONTINUE.  COMPUTATIONS MAY TAKE SEVERAL MINUTES.
                 1 BE PATIENT ',65,&400)
0457          391 CALL GWAIT
0458              IF (N.EQ.30) GO TO 203
0459              IF(N.EQ.1) GO TO 801
0460              IF(N.EQ.31) GO TO 210
0461              GO TO 391
0462          801 CONTINUE
0463          802 REWIND NW1
0464              CALL GERAS(1C0)
0465              CALL GRRLSE
0466              RETURN
            C
            C
0467          400 GO TO(203,206,213,201,224,237,225,228,241,246,285,210,604),NSTEP
0468          401 CALL GRDPLY('FORMAT ERROR.  REENTER DATA.',28,&400)
0469              IF(NSTEP.EQ.12)KODE=KODE+1
0470              GO TO(210,210,812,210,804,210,210,806,210,807,210,808,809),NSTEP
0471          402 IF(ITYPE.EQ.1.AND.N.EQ.30)GO TO 203
0472              IF(ITYPE.EQ.1.AND.N.EQ.31)GO TO 210
0473              CALL GRDPLY('YOU SHOULD BE IN A POSITION REQUIRING EOB SEQUENCE.',
                 151,&400)
0474              IF(NSTEP.EQ.12)KODE=KODE+1
0475              GO TO (210,811,812,803,804,210,805,806,210,807,210,808,809),NSTEP
0476          380 INDEX=4
0477              IF(TEXT(2).NE.BLANK) GO TO 384
0478              NBACK=1
0479              GO TO 382
0480          384 CALL INX(TEXT,INDEX,NC,DNP,&503)
0481              NBACK=DNP+.01
0482          382 NNBACK=NBACK
0483              IF(NVBL.LE.5) GO TO 385
0484              NNBACK=2*NNBACK
0485          385 CALL GBKSP(NNBACK)
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FORTRAN IV G LEVEL  19                  INPUT          DATE = 71253        13/24/17

0486                KOUNT=KOUNT-NBACK-1
0487                DO 383 I=1,NBACK
0488             383  BACKSPACE NW1
0489                IREC3=IREC3-NNBACK
0490                GO TO 294
0491             500  CALL GERAS(1)
0492                GO TO 374
0493             502  CALL GERAS(1)
0494                GO TO 378
0495             503  CALL GRDPLY('FORMAT ERROR.  PLEASE TRY AGAIN.',32,6504)
0496                GO TO 508
0497              504 CALL GERAS(1)
0498                GO TO 503
0499              507 CALL GRDPLY('FORMAT ERROR.  REENTER DATA.',28,6509)
0500                KODE=KODE+1
0501                GO TO 508
0502             509  CALL GERAS(1)
0503                GO TO 507
0504              210 CALL GERAS(100)
0505                CALL GRRLSE
0506                STOP
                 C
                 C
0507              1001 REWIND NW1
0508                CALL GOPEK(MASK4,PEINT)
0509                IFLH=2
0510                IREC3=502
0511                READ(N3'IREC3)TTL,VNAM,FNAM,NLVL,NEND,LEVEL,NTRAN,NVBL
0512                IREC3=510
0513                READ(N3'IREC3)NSUBJ
0514                IREC3=1
0515                INCR=1
0516                IF(NVBL.GT.5)INCR=2
0517              604 IQ=0
0518                NSTEP=13
0519                IRECX=IREC3
0520                CALL GERAS(100)
0521             5999 FORMAT(20A4)
0522              603 DO 610 IY=1,INCR
0523                READ(N3'IREC3,5999)TEXT3
0524                IQ=IQ+1
0525              610 CALL GRDPLY(TEXT2,NC2,6400)
0526                IF(IQ.LT.40.AND.IREC3.LE.INCR+NSUBJ+INCR)GO TO 603
0527                CALL GRDPLY(' ',1,6400)
0528                CALL GRDPLY('PRESS KEY 1 TO CONTINUE OR KEY 2 TO CHANGE DATA.',48,
                   16400)
0529                CALL GRDPLY('IF, AT ANY TIME, YOU WISH TO RETURN TO YOUR PREVIOUS'
                   ',52,6400)
0530                CALL GRDPLY('UNIVARIATE ANALYSIS OUTPUT, PRESS KEY 29.',41,6400)
0531                CALL GRDPLY('IF YOU WISH TO SEE THE PLOTS OF YOUR DATA, PRESS KEY
                   16.',55,6400)
0532              602 CALL GWAIT
0533                IF(N.LO.6)GO TO 660
0534                IF(N.EQ.29)GO TO 602
0535                IF(N.LO.30)GO TO 203
0536                IF(N.EQ.31)GO TO 210
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FORTRAN IV G LEVEL  19                  INPUT                DATE = 71253          13/24/17

0537                IF(N.EQ.1.AND.IREC3.GT.INCR*NSUBJ)GO TO 670
0538                IF(N.EQ.1) GO TO 604
0539                IF(N.EQ.2)GO TO 606
0540                GO TO 602
0541          606 CALL GERSP(4)
0542                CALL GRDPLY('IF YOU WISH TO DELETE AN ENTIRE RECORD, TYPE "DROP" A
                   1ND ITS',59,6400)
0543                CALL GRDPLY('RECORD NUMBER.',14,6400)
0544                CALL GRDPLY('IF YOU WISH TO MAKE CHANGES IN A RECORD, TYPE ITS REC
                   .1ORD NUMBER',63,6400)
0545                CALL GRDPLY('AND THE NEW RECORD IN THE ORIGINAL FORMAT.  SEPARATE
                   1ALL NUMBERS',64,6400)
0546                CALL GRDPLY('BY COMMAS.     YOU MAY NOW ENTER YOUR CHANGES.',46,
                   16400)
0547          809 CALL GWAIT
0548                IF(N.EQ.29)GO TO 802
0549                IF(ITYPE.NE.3)GO TO 402
0550          625 CALL GRRPLY(TEXT,NC)
0551                CALL XBLANK(TEXT,NC)
0552                IF(TEXT(1).EQ.ORGP)GO TO 614
0553                INDEX=0
0554                NVX=NVBL+3
0555                DO 611 KS=1,NVX
0556                KSS=KS
0557                CALL INX(TEXT,INDEX,NC,DNP,6401)
0558                SETUP(KS)=DNP
0559          611 CONTINUE
0560                DO 616 KS=1,NVBL
0561          616 X(KS)=SETUP(KS+3)
0562          628 IRC=SETUP(1)
0563                IF(IRC.GT.NSUBJ)NSUBJ=NSUBJ+1
0564                ISET(1)=SETUP(2)
0565                ISET(2)=SETUP(3)
0566          629 IREC3=(IRC-1)*INCR+1+INCR
0567              WRITE(N3'IREC3,396)IRC,ISET(1),ISET(2),(X(KT),KT=1,NVBL)
0568          630 IREC3=IRECX
0569                GO TO 604
0570          614 INDEX=4
0571                CALL INX(TEXT,INDEX,NC,DNP,6401)
0572                IRC=DNP
0573                ISET(1)=0
0574                ISET(2)=0
0575                DO 626 JQ=1,NVBL
0576          626 X(JQ)=OUTL
0577                GO TO 629
0578          660 REWIND N3
0579                IREC3=INCR+1
0580                NVBX=NVBL+3
0581                KCCT=0
0582          664 IF(KCCT.GE.NSUBJ)GO TO 802
0583                KCCT=KCCT+1
0584                READ(N3'IREC3,396)(ISET(IR),IR=1,3),(SETUP(IV),IV=4,NVBX)
0585                ISET(1)=ISET(2)
0586                ISET(2)=ISET(3)
0587                DO 661 KB=1,NVBL
0588          661 X(KB)=SETUP(KB+3)
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FORTRAN IV G LEVEL 19          INPUT          DATE = 71253          13/24/17

0589              GO TO 421
0590          670 CALL GERASE(160)
0591              CALL GRDPLY(' ',1,6400)
0592              CALL GRDPLY('IF YOU WOULD LIKE TO INDICATE NEW TRANSFORMATIONS FOR
                 1',53,6400)
0593              CALL GRDPLY('ANY OF YOUR RESPONSE VARIABLES, PRESS KEY 2.',44,
                 16400)
0594              CALL GRDPLY('IF YOU WISH TO CONTINUE TO YOUR UNIVARIATE ANALYSIS,'
                 1,52,6400)
0595              CALL GRDPLY('PRESS KEY 1.',12,6400)
0596          675 CALL GWAIT
0597              IF(N.EQ.30)GO TO 203
0598              IF(N.EQ.31)GO TO 210
0599              IF(N.EQ.1) GO TO 660
0600              IF(N.EQ.2)GO TO 224
0601              GO TO 675
0602              END
```

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FORTRAN IV G LEVEL  19                PMATX           DATE = 71253        13/24/17

0001          SUBROUTINE PMATX(NI,NJ)
              C
              C     GENERATES INCIDENCE MATRICES AND SUBTOTALS MATRICES
              C     FOR A FACTOR PAIR, FOR ALL RESPONSE VARIABLES.
              C
              C     AN INITIAL DECISION IS MADE ON THE VALUE OF MULT
              C           IF MULT = 0       DO THE MULTIVARIATE ANALYSIS
              C           IF MULT = 1       DO UNIVARIATE ANALYSES
              C
              C
0002          COMMON N,IGVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
             1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACY,NG12,MULT,
             2NSUBJ,NLUV ,NW1,NW2,NT,ISEC,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC3
             3,NTRAN(10),TRAN(10),LUV(10),NNLUV(10)
0003          DOUBLE PRECISION A,B,C,DSQU,DSSCP
0004          DIMENSION DSQU(10),DSSCP(10,10),SETUP(13),DSS(12,12,10),SUBT(12,12
             1,10),ISET(13),NN(12,12,10)
0005          EQUIVALENCE (SETUP(1),ISET(1))
0006          REWIND NW1
0007          IF(NSUBJ.GT.500) GO TO 99
0008          CUTL=-999.
0009          DO 500 K=1,10
0010          DSQU(K) = 0.000
0011          DO 500 I = 1,12
0012          DO 500 J = 1,12
0013          NN(I,J,K) = 0.0
0014          DSS(I,J,K) = 0.0
0015          SUBT(I,J,K) = 0.0
0016        500 CONTINUE
0017          DO 1500 II=1,10
0018          DO 1500 JJ=1,10
0019       1500 DSSCP(II,JJ) = 0.00
0020          IF(MULT)511,510,511
              C
              C     UNIVARIATE PROCEDURE
0021        511 CONTINUE
0022          DO 600 I=1,NSUBJ
0023          READ (NW1) SETUP
0024          MI = ISET(NI)
0025          MJ = ISET(NJ)
0026          DO 501 K = 1,NVBL
0027          CK=SETUP(K+2)
0028          IF(CK-CUTL)503,501,503
0029        503 NN(MI,MJ,K) = NN(MI,MJ,K) + 1
0030          SUBT(MI,MJ,K) = SUBT(MI,MJ,K) + SETUP(K+2)
0031          DSS(MI,MJ,K) = DSS(MI,MJ,K) + SETUP(K+2)*SETUP(K+2)
0032          DSQU(K)=DSQU(K)+(DBLE(SETUP(K+2)))**2
0033        501   CONTINUE
0034        600 CONTINUE
0035          GO TO 529
              C
              C     MULTIVARIATE PROCEDURE
0036        510   CONTINUE
0037          NVBL1=NVBL-1
0038          NLUV=0
0039          DO 191 J=1,NVBL
```

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FORTRAN IV G LEVEL 19          PNATX          DATE = 71253          13/24/17

0040          191 IF(LUV(J).NE.0) NLUV=NLUV+1
0041              IF(LUV(NVBL).EQ.0) LUV(NVBL)=99
0042              ITEMP=NVBL
0043              NVBL=NLUV
0044              NLUV=ITEMP
0045              DO 700 I=1,NSUBJ
0046              READ (NW1) SETUP
0047              IF(SETUP(13)-1.)506,700,700
0048          506 CONTINUE
0049              DO 300 J=1,NVBL1
0050              IF(LUV(J).NE.0) GO TO 300
0051          302 DO 301 K=J,NVBL1
0052              LUV(K)=LUV(K+1)
0053          301 SETUP(K+2)=SETUP(K+3)
0054              IF(LUV(J).EQ.0) GO TO 302
0055          300 CONTINUE
0056              MI = ISET(NI)
0057              MJ = ISET(NJ)
0058              DO 505 K = 1,NVBL
0059              NN(MI,MJ,K) = NN(MI,MJ,K) + 1
0060              SUBT(MI,MJ,K) = SUBT(MI,MJ,K) + SETUP(K+2)
0061              DSS(MI,MJ,K) = DSS(MI,MJ,K) + SETUP(K+2)*SETUP(K+2)
0062              DO 505 LM=1,NVBL
0063              A=DBLE(SETUP(K+2))
0064              B=DBLE(SETUP(LM+2))
0065              C=DSSCP(K,LM)
0066              C=C+A*B
0067              DSSCP(K,LM)=C
0068          505 CONTINUE
0069              DO 650 IAM=1,10
0070          650 LUV(IAM)=MALLV(IAM)
0071          700 CONTINUE
0072          504 CONTINUE
0073          512 CONTINUE
0074              DO 520 K=1,NVBL
0075              DSQU(K)=DSSCP(K,K)
0076          520 CONTINUE
0077          529 REWIND NW1
0078              REWIND NW2
0079              WRITE(NW2) DSSCP
0080              WRITE(NW2) NN
0081              WRITE(NW2) DSS
0082              WRITE(NW2) SUBT
0083              WRITE(NW2) DSQU
0084              RETURN
0085           99 WRITE(6,98)NSUBJ
0086           98 FORMAT('   NSUBJ = ', I10)
0087              STOP
0088              END
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FORTRAN IV G LEVEL 19          RAINC          DATE = 71253          13/24/17
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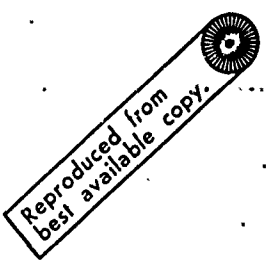

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FORTRAN IV G LEVEL 19          MAIN          DATE = 71253          13/24/17

0052              READ(NW2) DSQU
0053              DSQV = DSQU(K)
0054              CALL AMDT(NN1,SUB,K,1 ,2 ,DSQV,SS,RE,CE,Q,QB)
0055            120 CONTINUE
0056              DUMB=0.
0057              KK=K-1
0058              IF(K.GT.1) GO TO 146
0059            148 WRITE(NW2) NI,NJ,K,SUB,RE,CE,Q,QB
0060              GO TO 907
0061            146 DO 145 IX=1,KM
0062            145 READ(NW2) DUMB,DUMB,DUMB,SS,DUM,DUM,DUM,DUM
0063              GO TO 148
0064            907  CONTINUE
0065              IF(MULT.EQ.0)GO TO 350
0066           1051 KKOUN=KOUNT-2
0067              WRITE(N1'IREC1,2050)KKOUN
0068              WRITE(N1'IREC1,2003)
0069              WRITE(N1'IREC1,2051)
0070              WRITE(N1'IREC1,2052)
0071              WRITE(N1'IREC1,2053)
0072              WRITE(N1'IREC1,2054)
0073              DO 309 I=1,43
0074            309 WRITE(N2'IREC2,2003)
0075              DO 310 I=1,57
0076            310 WRITE(N1'IREC1,2003)
0077            350 WRITE(NW2)NN1
0078              IF(MULT) 136,130,136
0079            136  ISEQ = 17
0080              GO TO 138
0081            130  ISEQ = 396
0082            138  RETURN
0083           2001 FORMAT(55X,'PAGE',I4,'L',16X)
0084           2003 FORMAT(80X)
0085           2041 FORMAT('AT THIS POINT YOU SHOULD INSPECT YOUR UNIVARIATE RESULTS V
                   1ERY',19X)
0086           2042 FORMAT('CAREFULLY.',70X)
0087           2043 FORMAT('IS THERE A LARGE INTERACTION VERSUS ERROR F-RATIO?',30X)
0088           2044 FORMAT('THIS MAY INDICATE THE PRESENCE OF OUTLIERS OR FAULTY DATA.
                   1',22X)
0089           2045 FORMAT('CHECK THE TABLE OF CELL TOTALS OF VARIABLES WITH LARGE F-R
                   1ATIOS',17X)
0090           2046 FORMAT('FOR LARGE STANDARD DEVIATIONS OR FOR A CELL MEAN WHICH DEV
                   1IATES',17X)
0091           2047 FORMAT('IRREGULARLY FROM A TREND IN ROWS OR COLUMNS.',36X)
0092           2048 FORMAT('AFTER YOU HAVE CHECKED THESE RESULTS YOU CAN CHECK AND EDI
                   1T',21X)
0093           2049 FORMAT('YOUR DATA.',70X)
0094           2050 FORMAT('PAGE',I3,' WAS THE LAST PAGE OF YOUR UNIVARIATE RESULTS.',
                   127X)
0095           2051 FORMAT('YOU NOW HAVE THE FOLLOWING OPTIONS:',45X)
0096           2052 FORMAT('PRESS  KEY 4 TO CONTINUE TO YOUR MULTIVARIATE RESULTS',
                   126X)
0097           2053 FORMAT(12X,'5 TO SEE AND EDIT YOUR DATA',41X)
0098           2054 FORMAT(12X,'6 TO SEE PLOTS OF YOUR DATA',41X)
0099              END
```

```
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0001          SUBROUTINE ANOT (NN1,SUB,IV,IA,IB,GSQU,SQR,RE,CE,Q,QB)
              C
              C     UNIVARIATE ANALYSIS OF IRREGULAR TWO-WAY FACTORIAL
              C
0002          COMMON N,ICVLV,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
             1LEVCL(2,12),NRA,NCA,NAB,NCU,JAB(8),N1,N2,NVBL,NFACT,NG12,MULT,
             2NSUBJ,NLUV ,NW1,NW2,NT,ISEC,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC3
             3,NTRAN(10),TNAM(10),LUV(30),NNLUV(10)
0003          DOUBLE PRECISION G,GN,S&TO,S,FN,DSQU,SSE,SSSB,SO,DR,DC
0004          DIMENSION CR(12),DC(12)
0005          DIMENSION  SUB(12,12),R(12),C(12),Q(12),SUBX(12,12),CX(12,12),
             1    RE(12),CE(12),SQR(12,12),SQRX(12,12),QB(12),
             2NN1(12,12),NTOT(12),NDOTJ(12),NX(12,12),JLVA(12),JLVB(12)
0006          DIMENSION TEXT2(60)
0007          DATA BLANK/'    '/
0008          NR=NLVL(IA)                                                    011
0009          NC=NLVL(IB)                                                    012
0010          NFA=IA                                                         013
0011          NFB=IB                                                         014
0012          IFLAG = 0
0013          ILINK = 12
0014          ITG=0                                                          015
0015          IF(NR-NC)11,11,1                                               016
0016        1 DO 2 I = 1,NC
0017          DO 2 J =1,NR
0018          NX(I,J)=NN1(J,I)
0019          SQRX(I,J)=SQR(J,I)                                             020
0020        2 SUBX(I,J)=SUB(J,I)                                             021
0021          ITMP=NR                                                        022
0022          NR=NC                                                          023
0023          NC=ITMP                                                        024
0024          NFA=IB                                                         025
0025          NFB=IA                                                         026
0026          IFLAG = 1
0027          GO TO 13                                                       027
0028       11 DO 12 I=1,NR                                                   028
0029          DO 12 J =1,NC                                                  029
0030          NX(I,J)=NN1(I,J)
0031          SQRX(I,J)=SQR(I,J)                                             031
0032       12 SUBX(I,J)=SUB(I,J)                                             032
0033       13 DO 24 I=1,NR
0034       24 JLVA(I)=NEND(NFA,I)                                           034
0035          I=1                                                            035
0036       14 NSUM=0                                                         036
0037          DO 16 J=1,NC                                                   037
0038       16 NSUM=NSUM+NX(I,J)                                              038
0039          IF(NSUM)17,17,18                                               039
0040       17 NR=NR-1                                                        040
0041          IF(I-NR)21,22,22                                               041
0042       21 DO 19 K=I,NR                                                   042
0043          DO 20 L = 1,NC                                                 043
0044          SQRX(K,L)=SQRX(K+1,L)                                          044
0045          SUBX(K,L)=SUBX(K+1,L)                                          045
0046       20 NX(K,L)=NX(K+1,L)                                              046
0047       19 JLVA(K)=JLVA(K+1)                                             047
0048          GO TO 23                                                       048
```

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```
0049          10 I = I+1                                                    049
0050          23 IF(I-NR)14,14,22                                           050
0051          22 DO 44 J=1,NC                                               051
0052          44 JLVB(J)=NEPO(NPO,J)                                        052
0053             J=1                                                        053
0054          34 NSUM=0                                                     054
0055             DO 36 I=1,NR                                               055
0056          36 NSUM=NSUM+NX(I,J)                                          056
0057             IF(NSUM)37,37,38                                           057
0058          37 NC=NC-1                                                    058
0059             IF(J-NC)41,42,42                                           059
0060          41 DO39 K=J,NC                                                060
0061             DO 40 L=1,NR                                               061
0062             SUBX(L,K)=SUBX(L,K+1)                                      062
0063             SORX(L,K)=SORX(L,K+1)                                      063
0064          40 NX(L,K)=NX(L,K+1)                                          064
0065          39 JLVB(K)=JLVB(K+1)                                          065
0066             GO TO 43                                                   066
0067          38 J=J+1                                                      067
0068          43 IF(J-NC)34,34,42                                           068
0069          42 DO 50 I=1,NR                                               069
0070             NIDOT(I)=0                                                 070
0071             R(I)=0.                                                    071
0072             DR(I)=0.00                                                 072
0073             DO 50 J=1,NC                                               073
0074             NIDOT(I)=NIDOT(I)+NX(I,J)                                  074
0075             DR(I)=DR(I)+DBLE(SUBX(I,J))                                075
0076          50 R(I)=R(I)+SUBX(I,J)                                        076
0077             DO 51 J=1,NC                                               077
0078             NDOTJ(J)=0                                                 078
0079             C(J)=0.                                                    079
0080             DC(J)=0.00                                                 080
0081             DO 51 I=1,NR                                               081
0082             NDOTJ(J)=NDOTJ(J)+NX(I,J)                                  082
0083             DC(J)=DC(J)+DBLE(SUBX(I,J))                                083
0084          51 C(J)=C(J)+SUBX(I,J)                                        084
0085             G=0.00                                                     085
0086             GM = 0.00                                                  086
0087             SSTO = 0.00                                                087
0088             NN=0                                                       088
0089             DO 52 I=1,NR                                               089
0090             S = DR(I)                                                  090
0091             G=S+G                                                      091
0092          52 NN=NN+NIDOT(I)                                             092
0093             FN=0.000                                                   093
0094             FN=NN                                                      094
0095             GM=G/FN                                                    095
0096             SSTO=DSQU-G*GM                                             096
0097             NDFTO=NN-1                                                 097
0098             NDFSB=-1                                                   098
0099             SSSB=0.000                                                 099
0100             DO 55 I=1,NR                                               100
0101             DO 55 J=1,NC                                               101
0102             J=J                                                        102
0103             IF(NX(I,J))55,55,57                                        103
0104          57 S=DBLE(SUBX(I,J))                                          104
```

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0105            SSSB=SSSB+SNS*DFLOAT(NX(I,J))
0106            NDFSB = NDFSB + 1                                          100
0107         55 CONTINUE                                                   101
0108            SSSB=SSSB-G*GM
0109            SSE = 0.000
0110            SSE=SSTO-SSSB
0111            IF(SSE) 155,155,156                                        107
0112        155 SSE = 0.000
0113        156 NDFE = NDFTO - NDFSB                                       110
0114            DO 60 I=1,NR                                               132
0115            AI = FLOAT (NIDOT(I))
0116            Q(I) = DR(I)
0117            DO 62 K=I,NR                                               135
0118            SUM = 0.                                                   136
0119            DO 61 J=1,NC                                               137
0120            AKJ = FLOAT (NX(K,J))
0121            AIJ = FLOAT (NX(I,J))
0122         61 SUM = SUM - AIJ*AKJ/FLOAT (NDOTJ(J))
0123            CX(I,K) = SUM
0124            IF(I-K) 63,64,63                                           142
0125         64 CX(I,K) = CX(I,K) + AI                                     143
0126         63 CX(K,I) = CX(I,K)                                          144
0127         62 CONTINUE                                                   145
0128            DO 65 JU=1,NC                                              146
0129         65 Q(I) = DBLE(Q(I))-DFLOAT(NX(I,JU))*DC(JU)/DFLOAT(NDOTJ(JU))
0130         60 CONTINUE                                                   148
0131            DO 288 J=1,NC
0132            QB(J)=DC(J)
0133            DO 289 I=1,NR
0134        289 QB(J)= QBLE(QB(J))-DFLOAT(NX(I,J))*DR(I)/DFLOAT(NIDOT(I))
0135        288 CONTINUE
0136            NRM = NR - 1                                               158
0137            RE(NR) = 0.                                                159
0138            IF(NRM) 100,100,70                                         160
0139         70 DO 71 I=1,NRM                                              161
0140            Q(I) = Q(I) - Q(NR)                                        162
0141            DO 72 K=1,NRM                                              163
0142         72 CX(I,K) = CX(I,K) - CX(I,NR) - CX(NR,K) + CX(NR,NR)        164
0143         71 CONTINUE                                                   165
0144            CALL EQSYM(CX,Q,RE,NRM)                                    172
0145            DO 114 I =1,NRM
0146        114 Q(I) = Q(I) + Q(NR)
0147            DO 79 I=1,NRM
0148         79 RE(NR) = RE(NR) - RE(I)                                    174
0149        100 DO 82 J=1,NC                                               175
0150            CE(J)=DC(J)
0151            DO 83 I=1,NR                                               177
0152         83 CE(J)=CE(J)-RE(I)*FLOAT (NX(I,J))                          178
0153         82 CE(J) = CE(J)/FLOAT (NDOTJ(J)) - GM                        179
0154        216 CONTINUE
0155            NSTEP=1
0156            IREC=(IREC1-1
0157            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0158       1002 WRITE(N1'IREC1,2004) (TI(I),I=1,8)
0159            WRITE(N2'IREC2,2005) (TI(I),I=9,15)
0160            IF(MULT.EQ.1)WRITE(N1'IREC1,2006)VNAM(IV)
```

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0161                IF(NOL.EQ.0)WRITE(N1'IREC1,2006)TNAM(IV)
0162                WRITE(N2'IREC2,2007)FNAM(NFA),FNAM(NFB)
0163                WRITE(N1'IREC1,2008)FNAM(NFB)
0164                WRITE(N2'IREC2,2003)
0165                WRITE(N1'IREC1,2009)FNAM(NFA)
0166                WRITE(N2'IREC2,2010)
0167                WRITE(N1'IREC),2011)
0168                WRITE(N2'IREC2,2003)
0169                IF(NC.LE.6) GO TO 6001
0170                IF(NC.GT.6) GO TO 6002
0171          6001  WRITE(N1'IREC1,2012)(JLVB(IW),IW=1,NC)
0172                WRITE(N2'IREC2,2003)
0173                GO TO 6003
0174          6002  WRITE (N1'IREC),2012)(JLVB(IW),IW=1,6)
0175                WRITE(N2'IREC2,2013)(JLVB(IW),IW=7,NC)
0176          6003  CONTINUE
0177          96    DO 92 I=1,KK
0178                R(I) = R(I)/(FLOAT (NDOT(I))                                          198
0179                DO 93 J=1,NC                                                          199
0180                GN = NX(I,J)                                                          200
0181                IF (GN-1.) 201,202,203                                                201
0182          203   SUBX(I,J) = SUBX(I,J)/GN                                              202
0183                SQRX(I,J)=SQRT(ABS((SQRX(I,J)-GN*SUBX(I,J)**2)/(GN-1.)))
0184                GO TO 93                                                              204
0185          202   SQRX(I,J) = 0.                                                        205
0186                GO TO 93                                                              206
0187          201   SUBX(I,J)=0.                                                          207
0188                SQRX(I,J)=0.                                                          208
0189          93    CONTINUE                                                              209
0190          92    CONTINUE                                                              210
0191                DO 266 J=1,NC                                                         211
0192          266   C(J) = C(J)/FLOAT (NDOTJ(J))                                          212
0193          97    CONTINUE
0194                DO 207 I=1,KK                                                         214
0195                NG = NDOT(I)                                                          215
0196                RG = R(I)                                                             216
0197          209   JLVX = JLVA(I) - (JLVA(I)/100)
0198                NSTEP=2
0199                IREC=IREC1-1
0200                IF (MOD(IREC,45) .EQ. 0) GO TO 1001
0201          1003  WRITE(N1'IREC),2003)
0202                WRITE(N2'IREC2,2003)
0203                NSTEP=3
0204                IREC=IREC1-1
0205                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0206                NC1=NC+1
0207                SUBX(I,NC1)=RG
0208          1004  IF(NC1.LE.6)GO TO 6004
0209                IF(NC1.GT.6)GO TO 6005
0210          6004  WRITE(N1'IREC1,2014)JLVX,(SUBX(I,J),J=1,NC1)
0211                WRITE(N2'IREC2,2003)
0212                GO TO 6006
0213          6005  WRITE(N1'IREC1,2014)JLVX,(SUBX(I,J),J=1,6)
0214                WRITE(N2'IREC2,2015)(SUBX(I,J),J=7,NC1)
0215          6006  CONTINUE
0216                NSTEP=4
```

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0217                IREC=IREC1-1
0218                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0219                NX(1,NC1)=NG
0220          1005  IF(NC1.LE.6)GO TO 6007
0221                IF(NC1.GT.6) GO TO 6008
0222          6007  WRITE(N1'IREC1,2016)(NX(I,J),J=1,NC1)
0223                WRITE(N2'IREC2,2003)
0224                GO TO 6009
0225          6008  WRITE(N1'IREC1,2016)(NX(I,J),J=1,6)
0226                WRITE(N2'IREC2,2017)(NX(I,J),J=7,NC1)
0227          6009  CONTINUE
0228                NSTEP=5
0229                IREC=IREC1-1
0230                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0231          1006  IF(NC.LE.6)GO TO 6010
0232                IF(NC.GT.6)GO TO 6011
0233          6010  WRITE(N1'IREC1,2018)(SQRX(I,J),J=1,NC)
0234                WRITE(N2'IREC2,2003)
0235                GO TO 6012
0236          6011  WRITE(N1'IREC1,2018)(SQRX(I,J),J=1,6)
0237                WRITE(N2'IREC2,2019)(SQRX(I,J),J=7,NC)
0238          6012  CONTINUE
0239          207   CONTINUE                                              226
0240                NG = NN                                               227
0241                RG = GN                                               228
0242                NSTEP=6
0243                IREC=IREC1-1
0244                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0245          1007  WRITE(N1'IREC1,2003)
0246                WRITE(N2'IREC2,2003)
0247                NSTEP=7
0248                IREC=IREC1-1
0249                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0250          1008  WRITE(N1'IREC1,2020)
0251                WRITE(N2'IREC2,2003)
0252                NSTEP=8
0253                IREC=IREC1-1
0254                C(NC1)=RG
0255                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0256          1009  IF(NC1.LE.6)GO TO 6013
0257                IF(NC1.GT.6)GO TO 6014
0258          6013  WRITE(N1'IREC1,2018)(C(J),J=1,NC1)
0259                WRITE(N2'IREC2,2003)
0260                GO TO 6015
0261          6014  WRITE(N1'IREC1,2018)(C(J),J=1,6)
0262                WRITE(N2'IREC2,2015)(C(J),J=7,NC1)
0263          6015  CONTINUE
0264                NSTEP=9
0265                NDOTJ(NC1)=NG
0266                IREC=IREC1-1
0267                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0268          1010  IF(NC1.LE.6)GO TO 6016
0269                IF(NC1.GT.6) GO TO 6017
0270          6016  WRITE(N1'IREC1,2016)(NDOTJ(J),J=1,NC1)
0271                WRITE(N2'IREC2,2003)
0272                GO TO 6018
```

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0273          6017 WRITE(NT'IREC1,2015)(NDOTJ(J),J=1,6)
0274               WRITE(NT'IREC2,2017)(NCOTJ(J),J=7,NC1)
0275          6018 CONTINUE
                   C                                                      239
                   C     BEGIN ANALYSIS OF VARIANCE                       240
0276           215 SSRAD = 0.                                             241
0277               DO 221 I=1,NR                                          242
0278           221 SSRAD=SSRAD+RE(I)**2(I)                                243
0279               VSTO = SSTO/FLOAT (NDFTO)
0280               NDFRO = NR-1                                           245
0281               IF(NDFRO) 222,222,223                                  246
0282           222 VSRO = 0.                                              247
0283               GO TO 224                                              248
0284           223 VSRO = SSRAD/FLOAT (NDFRO)                             249
0285           224 S = 0.00
0286               DO 225 J=1,NC                                          251
0287           225 S = S + CC(J)**2/DFLOAT(NCOTJ(J))
0288               S = S-G*GR
0289               NDFINT = NDFTO - NDFRO - NC + 1                        254
0290               IF(NDFINT) 226,226,227                                 255
0291           226 NDFINT = 0                                             256
0292               VSINT = 0.                                             257
0293               GO TO 228                                              258
0294           227 SSINT = SSTO - DBLE(SSRAD) - S
0295               VSINT = SSINT/FLOAT (NDFINT)                           260
0296           228 SD = 0.00
0297               DO 229 I=1,NR                                          262
0298           229 SD = SD + CR(I)**2/DFLOAT(NROT(I))
0299               SD = SD - G*GR
0300               SSCAD = S-SD+DBLE(SSRAD)
0301               NDFCOL = NC-1                                          266
0302               IF(NDFCOL) 230,230,231                                 267
0303           230 VSCOL = 0.                                             268
0304               GO TO 232                                              269
0305           231 VSCOL = SSCAD/FLOAT (NDFCOL)                           270
0306           232 VSSD = SSSD/FLOAT (NDFSD)                              271
0307               IF(NDFE) 233,233,234                                   272
0308           233 FRO = 0.                                               273
0309               VSE = 0.
0310               FCOL = 0.                                              274
0311               FINT = 0.                                              275
0312               FSUB = 0.                                              276
0313               GO TO 235                                              277
0314           234 VSE = SSE/FLOAT (NDFE)                                 278
0315               FRO = VSRO/VSE                                         279
0316               FCOL = VSCOL/VSE                                       280
0317               FINT = VSINT/VSE                                       281
0318               FSUB = VSSD/VSE                                        282
0319           235 IF(VSINT) 237,237,238                                  283
0320           237 FROI = 0.                                              284
0321               FCOLI = 0.                                             285
0322               GO TO 239                                              286
0323           238 FROI = VSRO/VSINT                                      287
0324               FCOLI = VSCOL/VSINT                                    288
0325           239 GAM=0.
0326               DO 601 I=1,NR
```

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0327        601  GAM=GAM+RE(I)*FLOAT(NIDOT(I))/FLOAT(NN)
0328             DO 241 I=1,NR
0329        241  P(I) = RE(I) + SNGL(GM) - GAM
0330             IF(NRM) 244,244,245                                        291
0331        245  DO 240 I=1,NRR                                            292
0332             IP = I+1                                                  293
0333             DO 240 J=IP,NR                                            294
0334             IF(R(I)-R(J)) 242,240,240                                 295
0335        242  TEM = R(I)                                                296
0336             R(I) = R(J)                                               297
0337             R(J) = TEM                                                298
0338             ITEM = JLVA(I)                                            299
0339             JLVA(I) = JLVA(J)                                         300
0340             JLVA(J) = ITEM                                            301
0341        240  CONTINUE                                                  302
0342        244  NCM = NC-1                                                303
0343             DO 249 J=1,NC                                             304
0344         249 C(J)=CE(J)+GAM+SNGL(GM)
0345             IF(NCM) 246,246,247                                       306
0346        247  DO 250 I=1,NCM                                           307
0347             IP = I+1                                                  308
0348             DO 250 J=IP,NC                                            309
0349             IF(C(I)-C(J)) 252,250,250                                 310
0350        252  TEM = C(I)                                               311
0351             C(I) = C(J)                                               312
0352             C(J) = TEM                                                313
0353             ITEM = JLVA(I)                                            314
0354             JLVA(I) = JLVA(J)                                         315
0355             JLVA(J) = ITEM                                            316
0356        250  CONTINUE                                                  317
0357         246 CONTINUE
0358             NSTEP=11
0359             IREC=IREC1-1
0360             IF(NCD(IREC,45) .EQ. 0) GO TO 1001
0361        1012 WRITE(N1'IREC1,2003)
0362             WRITE(N2'IREC2,2003)
0363             NSTEP=10
0364             IREC=IREC1-1
0365             IF(NCD(IREC,45) .EQ. 0) GO TO 1001
0366        1011 WRITE(N1'IREC1,2023)FNAME(GFA)
0367             WRITE(N2'IREC2,2003)
0368             NSTEP=12
0369             IREC=IREC1-1
0370             IF(NCD(IREC,45) .EQ. 0) GO TO 1001
0371        1013 IF(NR.LE.6)GO TO 6019
0372             IF(NR.GT.6)GO TO 6020
0373        6019 WRITE(N1'IREC1,2016)(JLVA(I),I=1,NR)
0374             WRITE(N2'IREC2,2003)
0375             GO TO 6021
0376        6020 WRITE(N1'IREC1,2015)(JLVA(I),I=1,6)
0377             WRITE(N2'IREC2,2017)(JLVA(I),I=7,NR)
0378        6021 CONTINUE
0379             NSTEP=13
0380             IREC=IREC1-1
0381             IF(NCD(IREC,45) .EQ. 0) GO TO 1001
0382        1014 IF (NR.LE.6)GO TO 6022
```

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```
0383            IF(NR.GT.6)GO TO 6023
0384       6022 WRITE(N1'IREC1,2018)(R(I),I=1,NR)
0385            WRITE(N2'IREC2,2003)
0386            GO TO 6024
0387       6023 WRITE(N1'IREC1,2018)(R(I),I=5,6)
0388            WRITE(N2'IREC2,2019)(R(I),I=7,NR)
0389       6024 CONTINUE
0390            NSTEP=33
0391            IREC=IREC1-1
0392            IF(MOD(IREC,45).EQ.0) GO TO 1001
0393       1060 WRITE(N1'IREC1,2003)
0394            WRITE(N2'IREC2,2003)
0395            NSTEP=14
0396            IREC=IREC1-1
0397            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0398       1015 WRITE(N1'IREC1,2023)FNAM(NF8)
0399            WRITE(N2'IREC2,2003)
0400            NSTEP=15
0401            IREC=IREC1-1
0402            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0403       1016 IF(NC.LE.6)GO TO 6025
0404            IF(NC.GT.6)GO TO 6026
0405       6025 WRITE(N1'IREC1,2016)(JLV8(I),I=1,NC)
0406            WRITE(N2'IREC2,2003)
0407            GO TO 6027
0408       6026 WRITE(N1'IREC1,2016)(JLV8(I),I=1,6)
0409            WRITE(N2'IREC2,2017)(JLV8(I),I=7,NC)
0410       6027 CONTINUE
0411            NSTEP=16
0412            IREC=IREC1-1
0413            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0414       1017 IF(NC.LE.6) GO TO 6028
0415            IF(NC.GT.6) GO TO 6029
0416       6028 WRITE(N1'IREC1,2018)(C(I),I=1,NC)
0417            WRITE(N2'IREC2,2003)
0418            GO TO 6030
0419       6029 WRITE(N1'IREC1,2018)(C(I),I=1,6)
0420            WRITE(N2'IREC2,2019)(C(I),I=7,NC)
0421       6030 CONTINUE
0422       260  CONTINUE                                                    350
0423            NSTEP=17
0424            IREC=IREC1-1
0425            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0426       1018 WRITE(N1'IREC1,2003)
0427            WRITE(N2'IREC2,2003)
0428            NSTEP=18
0429            IREC=IREC1-1
0430            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0431       1019 IF(MULT.EQ.1)WRITE(N1'IREC1,2024)VNAM(IV)
0432            IF(MULT.EQ.0)WRITE(N1'IREC,2024)TNAM(IV)
0433            WRITE(N2'IREC2,2003)
0434            NSTEP=19
0435            IREC=IREC1-1
0436            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0437       1020 WRITE(N1'IREC1,2002)
0438            WRITE(N2'IREC2,2003)
```

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FORTRAN IV G LEVEL 19          ANDT          DATE = 71253          12/24/17

0439          NSTEP=20
0440          IREC=IREC1-1
0441          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0442       1021 WRITE(N1'IREC1,2025)
0443          WRITE(N2'IREC2,20261
0444          NSTEP=21
0445          IREC=IREC1-1
0446          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0447       1022 WRITE(N1'IREC1,2002)
0448          WRITE(N2'IREC2,2003)
0449          NSTEP=22
0450          IREC=IREC1-1
0451          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0452       1023 WRITE(N1'IREC1,2027)FNAM(NFA),NDFRO,SSRAD
0453          WRITE(N2'IREC2,2028)VSRO,FRO,FROI
0454          NSTEP=23
0455          IREC=IREC1-1
0456          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0457       1024 WRITE(N1'IREC1,2029)FNAM(NFB),NDFCOL,SSCAD
0458          WRITE(N2'IREC2,2028)VSCOL,FCOL,FCOLI
0459          NSTEP=24
0460          IREC=IREC1-1
0461          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0462       1025 WRITE(N1'IREC1,2030)FNAM(NFA),FNAM(NFB),NDFINT,SSINT
0463          WRITE(N2'IREC2,2031)VSINT,FINT
0464          NSTEP=25
0465          IREC=IREC1-1
0466          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0467       1026 WRITE(N1'IREC1,2003)
0468          WRITE(N2'IREC2,2005)
0469          NSTEP=26
0470          IREC=IREC1-1
0471          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0472       1027 WRITE(N1'IREC1,2032)NDFSB,SSSB
0473          WRITE(N2'IREC2,2033)VSSB,FSUB
0474          NSTEP=27
0475          IREC=IREC1-1
0476          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0477       1028 WRITE(N1'IREC1,2034)NDFE,SSE
0478          WRITE(N2'IREC2,2034) VSE
0479          NSTEP=28
0480          IREC=IREC1-1
0481          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0482       1029 WRITE(N1'IREC1,2035)NDFTO,SSTO
0483          WRITE(N2'IREC2,2036)VSTO
0484          IF(NDFE) 270,270,271                                    350
0485       271 RMSE = SQRT(VSE)                                       351
0486          NSTEP=29
0487          IREC=IREC1-1
0488          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0489       1030 WRITE(N1'IREC1,2003)
0490          WRITE(N2'IREC2,2003)
0491          NSTEP=30
0492          IREC=IREC1-1
0493          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0494       1031 WRITE(N1'IREC1,2003)
```

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FORTRAN IV G LEVEL 19          ANOT          DATE = 71253      13/24/17

0495            WRITE(N2'IREC2,2036)RMSE
0496        270 IF(NDFINT)2730,2730,274
0497        274 RMSIN = SQRT(VSIN1)                                        355
0498            NSTEP=31
0499            IREC=IREC1-1
0500            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0501       1032 WRITE(N1'IREC1,2003)
0502            WRITE(N2'IREC2,2037)RMSIN
0503       2730 NSTEP=32
0504       1049 IREC=IREC1-1
0505            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0506       1050 WRITE(N1'IREC1,2003)
0507            WRITE(N2'IREC2,2003)
0508            GO TO 1049
0509        273 IF(IFLAG) 293,293,294
0510        294 DO 295 I=1,ILINK
0511            R(I) = RE(I)
0512            C(I) = Q(I)
0513            RE(I) = CE(I)
0514            Q(I) = QB(I)
0515            CE(I) = R(I)
0516        295 QB(I) = C(I)
0517        293 CALL INTER(IV)
0518            RETURN
0519       2001 FORMAT(55X,'PAGE',I4,'L',16X/)
0520       2002 FORMAT(55X,'PAGE',I4,'R',16X/)
0521       2003 FORMAT(80X)
0522       2004 FORMAT(33X,8A4,15X/)
0523       2005 FORMAT(7A4,52X/)
0524       2006 FORMAT(35X,'VARIABLE ( ',A4,' ) TABLE OF MEANS',15X/)
0525       2007 FORMAT('AND EFFECTS ( ',A4,' ) VERSUS ( ',A4,' )',44X/)
0526       2008 FORMAT(' ROWS =',34X,'C O L U M N S = ',A6,17X)
0527       2009 FORMAT(A6,8X,'IN EACH BLOCK, ROW 1 DENOTES CELL MEANS, ROW 2 DENOT
               1ES',12X)
0528       2010 FORMAT(' CELL SIZE, AND ROW 3 DENOTES STANDARD DEVIATION.',31X)
0529       2011 FORMAT(' CODED',34X,'C O D E D  L E V E L S',18X)
0530       2012 FORMAT(' LEV.',I3,5I10,22X)
0531       2013 FORMAT(6I13,20X)
0532       2014 FORMAT(I2,1P6E10.3,16X)
0533       2015 FORMAT(1P6E10.3,20X)
0534       2016 FORMAT(5X,I3,5I10,22X)
0535       2017 FORMAT(7I10,10X)
0536       2018 FORMAT(2X,1P6E10.3,17X)
0537       2019 FORMAT(1P6E10.3,20X)
0538       2020 FORMAT(' COL.',7X)
0539       2023 FORMAT(55X,'ESTIMATES OF ',A4,'  ADJUSTED MEANS, ORDERED',23X)
0540       2024 FORMAT(20X,'ANALYSIS OF VARIANCE FOR VARIABLE ',A4,22X)
0541       2025 FORMAT(5X,'SOURCE OF VARIATION',14X,'D.F.',7X,'SUM OF SQUARES',17X
               1)
0542       2026 FORMAT(5X,'MEAN SQUARE',8X,'F VS. ERROR',3X,'F VS. INTERACTION',
               125X)
0543       2027 FORMAT(2X,A6,4X,'(ROWS)',I10,1PE20.6,18X)
0544       2028 FORMAT(1PE20.6,E17.3,26X)
0545       2029 FORMAT(8X,A6,4X,'(COLS)',I10,1PE20.6,18X)
0546       2030 FORMAT(5X,A6,'*',A6,'(INTERACTION)',I11,1PE20.6,18X)
0547       2031 FORMAT(1PE20.6,E17.3,43X)
```

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FORTRAN IV G LEVEL 19          ANOT          DATE = 71253          13/24/17

0548        2032 FORMAT(10X,'SUBTOTALS',25X,I8,1PE20.6,18X)
0549        2033 FORMAT(12X,'ERROR',7X,I18,1PE20.6,18X)
0550        2034 FORMAT(1PE20.6,60X)
0551        2035 FORMAT(12X,'TOTAL',7X,I18,1PE20.6,18X)
0552        2036 FORMAT('ROOT MEAN SQUARE ERROR = ',1PE20.6,35X)
0553        2037 FORMAT(7X,'ROOT MEAN SQUARE INTERACTION = ',1PE16.6,26X)
0554        1001 WRITE(N1'IREC1,2001)KOUNT
0555             WRITE(N2'IREC2,2002)KOUNT
0556             KOUNT=KOUNT+1
0557             GO TO (1002,1003,1004,1005,1006,1007,1008,1009,1010,1011,1012,
            1 1013,1014,1015,1016,1017,1018,1019,1020,1021,1022,1023,1024,1025,
            2 1026,1027,1028,1029,1030,1031,1032,273,1060),NSTEP                    359
0558             END
```

```
FORTRAN IV G LEVEL  19          EQSYM          DATE = 71253          13/24/17

0001          SUBROUTINE EQSYM(A,Q,B,NR)
              C
              C     SOLVE A POSITIVE SEMIDEFINITE OR POSITIVE DEFINITE
              C     SYMMETRIC EQUATION
              C
0002          COMMON N,IOVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
             1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NG12,MULT,
             2NSUBJ,NLOV ,NW1,NW2,NT,ISEG,NL2,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC3
             3,NYRAN(10),TNAM(10),LUV(10),MNLUV(10)
0003          DIMENSION A(12,12),Q(12),B(12),AA(78),T(78),D(13)
0004               IJ = 0                                                    010
0005               DO 1 J=1,NR                                               011
0006               DO 1 I=1,J                                                012
0007               IJ = IJ+1                                                 013
0008          1    AA(IJ) = A(I,J)                                           014
0009               NRA = NR                                                  015
0010               NRB = NR                                                  016
0011               NCA = NR                                                  017
0012               NCB = NR                                                  018
0013               CALL INSLD(AA,T,D)                                        019
0014               IX = 1                                                    020
0015               DO 2 I=1,NR                                               021
0016               IX = IX+I-1                                               022
0017               JX = I                                                    023
0018               B(I) = 0.                                                 024
0019               DO 6 J=1,NR                                               025
0020               IF(J-I) 3,3,4                                             026
0021          3    JX = J                                                    027
0022               GO TO 5                                                   028
0023          4    JX = JX+J-1                                               029
0024          5    IJ = IX + JX - 1                                          030
0025          6    B(I) = B(I) + T(IJ)*Q(J)                                  031
0026          2    CONTINUE                                                  032
0027               DO 10 I=1,NR                                              033
0028               SUM = 0.                                                  034
0029               DO 12 J=1,NR                                              035
0030          12   SUM = SUM + A(I,J)*B(J)                                   036
0031               IF(Q(I)) 13,14,13                                         037
0032          14   DEN = 1.                                                  038
0033               GO TO 15                                                  039
0034          13   DEN = ABS (Q(I))                                          040
0035          15   IF(ABS (SUM-C(I))/DEN - 1.E-5) 10,10,16
0036          10   CONTINUE                                                  042
0037               GO TO 20                                                  043
0038          16   CONTINUE
0039          20   RETURN                                                    046
0040               END                                                       047
```

```
FORTRAN IV G LEVEL 19          INTER          DATE = 71253          13/24/17

0001          SUBROUTINE INTER(IV)
0002          EXTERNAL PRINT
0003          COMMON N,YOVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
             1LEVEL(2,12),NRA,NCA,NRB,NCB,JAC(5),N1,N2,NVBL,NFACT,NG12,MULT,
             2NSUBJ,NDUV ,NV1 ,NV2,NF,ISEC,NIZ,NJZ,KOUNT,NG146,IREC1,IREC2,IREC3
             3,NTRAN(10),TNAM(10),LOV(10),FNLOV(10)
0004          DIMENSION TEX(115)
0005          DATA CSIZE/'2'/
0006          CALL GRINIT(CSIZE)
0007          MASK=1610612739
0008          CALL GCPFK(MASK,PRINT)
0009          CALL GERAS(100)
0010          CALL GROPLY(' ',1,6400)
0011          CALL GROPLY('THE ANALYSES ON THE FOLLOWING VARIABLES ARE NOW COMPL
             1ETE.',57,6400)
0012          IF(MULT.EQ.1)WRITE(4,25)(VNAM(IJ),IJ=1,IV)
0013          IF(MULT.EQ.0)WRITE(4,25)(TNAM(IJ),IJ=1,IV)
0014       25 FORMAT(1J(2X,A4))
0015          CALL PUTCH(TEXT,NCP,6400)
0016          CALL GROPLY(TEXT,NCP,6400)
0017          CALL GROPLY(' ',1,6400)
0018          CALL GROPLY('PRESS KEY 1 TO CONTINUE WITH CALCULATIONS OR KEY 2 TO
             1 STOP',50,6400)
0019          CALL GROPLY('CALCULATIONS AT THIS STAGE.',27,6400)
0020       10 CALL GWAIT
0021          IF(N.EQ.30.OR.N.EQ.1)GO TO 205
0022          IF(N.EQ.31)GO TO 210
0023          IF(N.EQ.2)GO TO 75
0024          GO TO 10
0025       75 NVBL=IV
0026      203 CALL GERAS(100)
0027          CALL GRELSE
0028          RETURN
0029      210 CALL GERAS(100)
0030          CALL GRELSE
0031          STOP
0032      400 GO TO 210
0033          END
```

```
FORTRAN IV G LEVEL  19              OUTPUT              DATE = 71253          13/24/17

0001                SUBROUTINE OUTPUT
0002                EXTERNAL PFINT
0003                COMMON N,IGVLY,ITYPE,TTL(5),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
                   1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NGLC,NUL1,
                   2NSUBJ,NLUV ,NN1,NN2,NT,ISEQ,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC3
                   3,NTRAN(10),TNAM(10),LUV(10),MNLUV(10)
0004                DIMENSION TEXT(18),TEXT2(20)
0005                EQUIVALENCE (TEXT(1),TEXT2(1))
0006                DATA CSIZE/'8'/
0007                CALL GRINIT(CSIZE)
0008                N=-1
0009                MASK1=2013265923
0010                MASK=2113929219
0011                NC=72
0012                IF(MULT.EQ.0)CALL GCPFK(MASK1,PFINT)
0013                IF(MULT.EQ.1) CALL GCPFK(MASK,PFINT)
0014                IREC1=1
0015                IREC2=1
0016              3 FORMAT(20A4)
0017                CALL GRDPLY(' ',1,&400)
0018                CALL GRDPLY(' ',1,&400)
0019                CALL GRDPLY('     KEYBOARD FUNCTIONS:',24,&400)
0020                CALL GRDPLY('       1     ALTERNATE PORTION OF CURRENT PAGE.',46,
                   1&400)
0021                CALL GRDPLY('       2     INCREMENT PAGE NUMBER.',34,&400)
0022                CALL GRDPLY('       3     DECREMENT PAGE NUMBER.',34,&400)
0023                CALL GRDPLY('      30     RESTART PROGRAM.',28,&400)
0024                CALL GRDPLY('      31     TERMINATE PROGRAM.',30,&400)
0025                CALL GRDPLY(' ',1,&400)
0026                IF(MULT.EQ.1 ) CALL GRDPLY('PRESS KEY 1 TO PROCEED TO THE FIRST PA
                   1GE OF YOUR UNIVARIATE RESULTS.',68,&400)
0027                IF(MULT.EQ.0 ) CALL GRDPLY('PRESS KEY 1 TO PROCEED TO THE FIRST PA
                   1GE OF YOUR MULTIVARIATE RESULTS.',70,&400)
0028              5 CALL GWAIT
0029                IF(N.EQ.1) GO TO 15
0030                IF(N.EQ.30) GO TO 75
0031                IF(N.EQ.31) GO TO 50
0032                GO TO 5
0033             15 CALL GERAS(100)
0034                DO 16 I=1,45
0035                READ(N'IREC1)TEXT2
0036             16 CALL GRDPLY(TEXT,NC,&400)
0037             17 CALL GWAIT
0038                IF(N.EQ.1) GO TO 30
0039                IF (N.EQ.2) GO TO 15
0040                IF(N.EQ.3) GO TO 32
0041                IF(N.EQ.4.OR.N.EQ.5.OR.N.EQ.6.OR.N.EQ.30)GO TO 75
0042                IF(N.EQ.31) GO TO 50
0043                GO TO 17
0044             25 CALL GERAS(100)
0045                DO 26 I=1,45
0046                READ(N2'IREC2)TEXT2
0047             26 CALL GRDPLY(TEXT,NC,&400)
0048             27 CALL GWAIT
0049                IF(N.EQ.1) GO TO 34
0050                IF(N.EQ.2) GO TO 25
```

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FORTRAN IV G LEVEL  19                  OUTPUT          DATE = 73253          13/24/17

0051                IF(N.EQ.3) GO TO 36
0052                IF(N.EQ.4.OR.N.EQ.5.OR.N.EQ.6.OR.N.EQ.30)GO TO 75
0053                IF(N.EQ.31) GO TO 50
0054                GO TO 27
0055             30 IREC2=IREC1-45
0056                GO TO 25
0057             32 IF(IREC1.EQ.46) GO TO 17
0058                IREC1=IREC1-90
0059                GO TO 15
0060             75 CALL GERAS(100)
0061                CALL GRRLSE
0062                RETURN
0063             34 IREC1=IREC2-45
0064                GO TO 15
0065             36 IF(IREC2.EQ.46) GO TO 27
0066                IREC2=IREC2-90
0067                GO TO 25
0068             50 CALL GERAS(100)
0069                CALL GRRLSE
0070                STOP
0071            400 CALL GERAS(100)
0072                WRITE(6,402)
0073            402 FORMAT(1H1,'ERROR')
0074                GO TO 50
0075                END
```

```
FORTRAN IV G LEVEL  19                  PLOT                DATE = 71253          13/24/17

0001                  SUBROUTINE PLOT
0002                  EXTERNAL PFINT,ECBINT
0003                  INTEGER XNVBL,YNVBL
0004                  COMMON N,IOVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
                     1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(6),N1,N2,NVBL,NFACT,NG12,MULT,
                     2NSUBJ,NLUV ,NW1,NW2,NT,ISEQ,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC3
                     3,NTRAN(10),TNAM(10),LUV(10),MNLUV(10)
0005                  DIMENSION X(100),Y(100),NCOUNT(100),NTEN(100),NHUND(100),
                     1MIXCH(3),MAXCH(3),MIYCH(3),MAYCH(3),TEXT(15),ISET(13),SETUP(15)
0006                  EQUIVALENCE (ISET(1),SETUP(1))
0007                  DOUBLE PRECISION DNP
0008                  DATA CSIZE/'B'/
0009                10 REWIND NW1
0010                  IMPY=-16777216
0011                  NR=NLVL(1)
0012                  NCC=NLVL(2)
0013                  MASK1=114C85C695
0014                  NSTEP=1
0015                  NC=60.
0016                  XSUM=0.0
0017                  YSUM=0.0
0018                  XSUM2=0.0
0019                  YSUM2=0.0
0020                  KOUNT=0
0021                  CALL GRINIT(CSIZE)
0022                  CALL GCECB(ECBINT)
0023                  CALL GCPEK(MASK1,PFINT)
0024                  CALL GERAS(100)
0025                  CALL GRDPLY(' ',1,6400)
0026                  CALL GRDPLY('AT THIS STAGE YOU MAY LOOK AT PLOTS OF YOUR DATA POIN
                     1TS.',5(,6400)
0027                  CALL GRDPLY('YOU HAVE THE CHOICE OF SEEING A CELL, A ROW, A COLUMN
                     1, OR',57,6400)
0028                  CALL GRDPLY('ALL YOUR DATA.  TO INDICATE YOUR CHOICE OF POINTS, TY
                     1PE IN',5d,6400)
0029                  CALL GRDPLY('THE LEVELS OF BOTH FACTORS.  IF YOU WISH TO SEE ALL L
                     1EVELS',5d,6400)
0030                  CALL GRDPLY('OF A FACTOR TYPE "0" FOR THE LEVEL.',35,6400)
0031                  CALL GRDPLY('EXAMPLE:  SUPPOSE FACTOR 1 IS DESIGNATED AS THE ROWS
                     1IN THE',59,6400)
0032                  CALL GRDPLY('          ANOVAR TABLE',22,6400)
0033                  CALL GRDPLY('             2,2      INDICATES BOTH LEVELS AT 2.',48,
                     16400)
0034                  CALL GRDPLY('             0,4      INDICATES THE 4TH COLUMN.',46,
                     16400)
0035                  CALL GRDPLY('             3,0      INDICATES THE 3RD ROW.',43,6400)
0036                  CALL GRDPLY('             0,0      INDICATES ALL POINTS.',42,6400)
0037                  CALL GRDPLY(' ',1,6400)
0038                185 DO 25 I=1,2
0039                  WRITE(4,26)FNAM(I)
0040                 26 FORMAT('WHICH LEVEL DO YOU WISH TO SEE OF ',A4,'?')
0041                  CALL FETCH(TEXT,NCF,6400)
0042                  CALL GRDPLY(TEXT,NCF,6400)
0043                  CALL GWAIT
0044                  IF(ITYPE.NE.3)GO TO 402
0045                  CALL GRRPLY(TEXT,NC)
```

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FORTRAN IV G LEVEL 19          PLOT          DATE = 71253          13/24/17

0046            CALL XBLANK(TEXT,NC)
0047            INDEX=0
0048            CALL INX(TEXT,INDEX,NC,DNP,&401)
0049            IF(I.EQ.1)NFAC1=DNP
0050            IF(I.EQ.2)NFAC2=DNP
0051         25 CONTINUE
0052        175 IF(NFAC1.GT.NN.OR.NFAC2.GT.NCC)GO TO 180
0053            CALL GRDPLY(' ',1,&400)
0054        191 CALL GRDPLY('WHICH VARIABLE DO YOU WISH TO ASSIGN TO THE X-AXIS?',
                 151,&400)
0055            NSTEP=2
0056        190 CALL GWAIT
0057            IF(ITYPE.NE.3)GO TO 402
0058            CALL GRDPLY(TEXT,NC)
0059            CALL XBLANK(TEXT,NC)
0060            VNAM1=TEXT(1)
0061            CALL GRDPLY('WHICH VARIABLE DO YOU WISH TO ASSIGN TO THE Y-AXIS?',
                151,&400)
0062            NSTEP=3
0063        195 CALL GWAIT
0064            IF(ITYPE.NE.3)GO TO 402
0065            CALL GRDPLY(TEXT,NC)
0066            CALL XBLANK(TEXT,NC)
0067            VNAM2=TEXT(1)
0068            XNVBL=-1
0069            YNVBL=-1
0070            DO 50 I=1,NVBL
0071            IF(VNAM1.EQ.VNAM(I)) XNVBL=I
0072         50 IF(VNAM2.EQ.VNAM(I)) YNVBL=I
0073            IF(XNVBL.EQ.-1.OR.YNVBL.EQ.-1)GO TO 450
0074            CALL GRDPLY(' ',1,&400)
0075            CALL GRDPLY(' ',1,&400)
0076            CALL GRDPLY('IF, AT ANY TIME, YOU WISH TO RETURN TO YOUR PREVIOUS'
                1,52,&400)
0077            CALL GRDPLY('UNIVARIATE ANALYSIS OUTPUT, PRESS KEY 29.',41,&400)
0078            CALL GRDPLY(' ',1,&400)
0079            CALL GRDPLY('TO RETURN TO THE BEGINNING OF THIS SEGMENT TO SEE',49
                1,&400)
0080            CALL  GRDPLY('ADDITIONAL PLOTS, PRESS KEY 1.',30,&400)
0081            CALL GRDPLY(' ',1,&400)
0082            CALL GRDPLY('TO SEE YOUR DATA AGAIN, PRESS KEY 5.',36,&400)
0083            I=0
0084            DO 75 N=1,NSUBJ
0085            READ(NRU) SETUP
0086            IF(NFAC1.EQ.0.AND.NFAC2.EQ.0)GO TO 76
0087            IF(NFAC1.EQ.0.AND.ISET(2).EQ.NFAC2)GO TO 76
0088            IF(NFAC1.EQ.ISET(1).AND.NFAC2.EQ.0)GO TO 76
0089            IF(ISET(1).EQ.NFAC1.AND.ISET(2).EQ.NFAC2)GO TO 76
0090            GO TO 75
0091         76 IF(SETUP(2+XNVBL).EQ.-999..OR.SETUP(2+YNVBL).EQ.-999.)GO TO 75
0092            I=I+1
0093            ACOUNT(I)=N
0094            NTEN(I)=MOD(NCOUNT(I),10)
0095            NHUN=(NCOUNT(I)-NTEN(I))/10
0096            NHUND(I)=MOD(NHUN,10)
0097            X(I)=SETUP(2+XNVBL)
```

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FORTRAN IV G LEVEL  19                 PLOT                 DATE = 71253          13/24/17

0098                 Y(I)=SETUP(2+YNVBL)
0099                 XSUM=XSUM+X(I)
0100                 YSUM=YSUM+Y(I)
0101                 XSUM2=XSUM2+X(I)*X(I)
0102                 YSUM2=YSUM2+Y(I)*Y(I)
0103                 KOUNT=KOUNT+1
0104              75 CONTINUE
0105                 IF(KOUNT.LE.1)GO TO 425
0106                 XMEAN=XSUM/FLOAT(KOUNT)
0107                 YMEAN=YSUM/FLOAT(KOUNT)
0108                 XSD=((XSUM2-XSUM*XSUM/FLOAT(KOUNT))/FLOAT(KOUNT-1))**.5
0109                 YSD=((YSUM2-YSUM*YSUM/FLOAT(KOUNT))/FLOAT(KOUNT-1))**.5
0110                 XMID=3*XSD
0111                 YMID=3*YSD
0112                 XMIN=XMEAN-XMID
0113                 XMAX=XMEAN+XMID
0114                 YMIN=YMEAN-YMID
0115                 YMAX=YMEAN+YMID
0116                 XDIS=2.*XMID/56.
0117                 WRITE(NT,101)XMIN,XMAX
0118             101 FORMAT(2(1PE10.3,2X))
0119                 BACKSPACE NT
0120                 READ(NT,102)MIXCH,MAXCH
0121             102 FORMAT(6A4)
0122                 CALL GETAS(100)
0123                 CALL GRELSE
0124                 NSTEP=4
0125                 CALL INITP
0126                 CALL PFKP(MASK1,PFINT)
0127                 CALL EGBP(EGBINT)
0128                 CALL GRAXES(0.,4092.,0.,4092.,0,4092,0,4092)
0129                 CALL GRCHAR('BP',MIXCH,10,376.,400.,KODEB)
0130                 CALL GRCHAR('BP',VNAM(XNVBL),4,2250.,400.,KODEH)
0131                 CALL GRCHAR('BP',MAXCH,10,3580.,400.,KODEB)
0132                 WRITE(NT,101)YMIN,YMAX
0133                 BACKSPACE NT
0134                 READ(NT,102)MIYCH,MAYCH
0135                 CALL GRCHAR('BP',MIYCH,10,0.,600.,KODEC)
0136                 CALL GRCHAR('BP',VNAM(YNVBL),4,100.,2329.,KODEH)
0137                 CALL GRCHAR('BP',MAYCH,10,0.,4092.,KODED)
0138                 CALL GRAXES(XMIN,XMAX,YMIN,YMAX,600,4012,600,4012)
0139                 CALL GRGRID(XMID,YMID,'A',KODEE)
0140                 DO 90 II=1,KCUNT
0141                 CALL UV00(2)
0142                 DO 91 KK=1,2
0143              91 CALL PUTUV(X(II),Y(II),KODEF)
0144                  ICT=IMPY*(16-NTEN(II))
0145                 CALL GRPLOT('BP','8','B',1 ,2,ICT,'0',KODEG)
0146                 CALL UV99
0147              90 CONTINUE
0148                 DO 95 II=1,KCUNT
0149                 IF(NROUND(II).EC.0.AND.NCOUNT(II).LT.10)GO TO 95
0150                 X(II)=X(II)-XDIS
0151                 CALL UV00(2)
0152                 DO 96 KK=1,2
0153              96 CALL PUTUV(X(II),Y(II),KODEF)
```

```
FORTRAN IV G LEVEL  19                PLOT                DATE = 71253          13/24/17

0154                  ICT=(ROW*(16-NROUND(II))
0155                  CALL GRPLOT('BP','B','B',1 ,2,ICT,'O',KODEG)
0156                   CALL UV99
0157               95 CONTINUE
0158              505 FORMAT(1H ,I10)
0159                  CALL GWAIT
0160               99 CALL REFILL
0161                  CALL RLSEP
0162                  IF(N.EQ.1)GO TO 10
0163                  IF(N.EQ.31)GO TO 299
0164                  RETURN
0165              400 CALL GSRAS(100)
0166                  GO TO 10
0167              401 CALL GRDPLY('FORMAT ERROR.  PLEASE REENTER DATA.',35,6400)
0168                  GO TO (185,259,299),NSTEP
0169              402 IF(ITYPE.EQ.1.AND.N.EQ.29)GO TO 99
0170                  IF(ITYPE.EQ.1.AND.N.EQ.30)GO TO 99
0171                  IF(ITYPE.EQ.1.AND.N.EQ.31)GO TO 299
0172                  CALL GRDPLY('YOU SHOULD BE IN A POSITION REQUIRING EOB.',42,6400)
0173                  GO TO (185,190,195),NSTEP
0174              180 CALL GRDPLY(' ',1,6400)
0175                  CALL GRDPLY('ONE OF YOUR LEVEL NUMBERS EXCEEDS THE NUMBER OF LEVEL
                     1S FOR THE FACTOR.',70,6400)
0176                  CALL GRDPLY('PLEASE REENTER YOUR SET OF POINTS.',34,6400)
0177                  GO TO 185
0178              425 CALL GRDPLY(' ',1,6400)
0179                  CALL GRDPLY(' ',1,6400)
0180                  CALL GRDPLY('DOES IT MAKE SENSE TO PLOT ONLY ONE POINT?',42,6400)
0181                  CALL GRDPLY('PRESS KEY 1 TO REENTER A NEW SET OF POINTS.',43,6400)
0182              426 CALL GWAIT
0183                  IF(N.EQ.1)GO TO 10
0184                  IF(N.EQ.31)GO TO 299
0185                  GO TO 426
0186              450 CALL GRDPLY(' ',1,6400)
0187                  CALL GRDPLY('PLEASE REENTER YOUR NAMES.',26,6400)
0188                  GO TO 191
0189              299 IF(NSTEP.EQ.4)GO TO 300
0190                  CALL GSRAS(100)
0191                  CALL GRRLSE
0192                   STOP
0193              300 CALL REFILL
0194                  CALL RLSEP
0195                  CALL UV99
0196                  STOP
0197                  END
```

```
FORTRAN IV G LEVEL 19          DELETE          DATE = 71253          13/24/17

0001              SUBROUTINE DELETE
0002              EXTERNAL PFINT,EOBINT
0003              COMMON N,IGVLV,ITYPE,TTL(15),VNAM(10),ENAM(2),NLVL(2),NEND(2,12),
                 1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NG12,MULT,
                 2NSUB,NLUV ,N1,N2,NT,ISEC,NI2,NJ2,KOUNT,NOTAG,IREC1,IREC2,IREC
                 3,NTRAN(10),TNAM(10),LUV(10),MNLUV(10)
0004              DATA CSIZE/'C'/
0005              DATA BLANK/'    '/
0006              MULT=0
0007              CALL GRINIT(CSIZE)
0008              CALL GCEGBI(EOBINT)
0009              MASK='610612739
0010              CALL GCMFK(MASK,PFINT)
0011           20 CALL GERAS(100)
0012              CALL GRDPLY(' ',1,6400)
0013              CALL GRDPLY(' ',1,6400)
0014              CALL GRDPLY('YOUR RESPONSE VARIABLE NAMES WILL APPEAR BELOW ONE AT
                 1 A TIME.',61,6400)
0015              CALL GRDPLY('PRESS KEY 1 IF YOU WISH TO INCLUDE THE VARIABLE OR KE
                 1Y 2 IF',59,6400)
0016              CALL GRDPLY('YOU WISH TO DELETE THE VARIABLE.',32,6400)
0017              CALL GRDPLY(' ',1,6400)
0018              IK=0
0019           25 IK=IK+1
0020              TEST=VNAM(IK)
0021              CALL GRDPLY(TEST,4,6400)
0022           26 CALL GWAIT
0023              IF(N.EQ.30)GO TO 203
0024              IF(N.EQ.31)GO TO 210
0025              IF(N.EQ.1)GO TO 29
0026              IF(N.EQ.2)GO TO 35
0027              GO TO 26
0028           29 LUV(IK)=IK
0029              MNLUV(IK)=IK
0030              TNAM(IK)=VNAM(IK)
0031              IF(IK.LT.NVBL)GO TO 25
0032              IF(IK.EQ.NVBL)GO TO 30
0033           35 CALL GBKSP(1)
0034              LUV(IK)=0
0035              MNLUV(IK)=0
0036              TNAM(IK)=BLANK
0037              IF(IK.EQ.NVBL)GO TO 30
0038              IF(IK.LT.NVBL)GO TO 25
0039           30 CALL GRDPLY(' ',1,6400)
0040              CALL GRDPLY(' ',1,6400)
0041              CALL GRDPLY('THE ABOVE VARIABLES ARE THE ONES YOU DECIDED TO INCLU
                 1DE.',56,6400)
0042              CALL GRDPLY('IF YOU AGREE, PRESS KEY 1;  IF YOU WOULD LIKE TO TRY
                 1AGAIN,',59,6400)
0043              CALL GRDPLY('PRESS KEY 2.',12,6400)
0044           32 CALL GWAIT
0045              IF(N.EQ.1)GO TO 50
0046              IF(N.EQ.2)GO TO 20
0047              IF(N.EQ.30)GO TO 203
0048              IF(N.EQ.31)GO TO 210
0049              GO TO 32
```

```
FORTRAN IV G LEVEL  19          DELETE          DATE = 71253      13/24/17

0050          50 IF(LUV(NVBL).EQ.0)TNAM(NVBL)=VNAM(NVBL)
0051             NVBL1=NVBL-1
0052             DO 150 IQ=1,NVBL1
0053             IF(TNAM(IQ).NE.BLANK)GO TO 150
0054          153 DO 152 JA=IQ,NVBL1
0055          152 TNAM(JA)=TNAM(JA+1)
0056             IF(TNAM(IQ).EQ.BLANK)GO TO 153
0057          150 CONTINUE
0058          203 CALL GERAS(100)
0059              CALL GRRLSE
0060              RETURN
0061          400 GO TO 203
0062          210 CALL GERAS(100)
0063              CALL GRRLSE
0064              STOP
0065              END
```

```
FORTRAN IV G LEVEL  19                MAINB           DATE = 71253        13/24/17

0001              SUBROUTINE MAINB
0002              COMMON N,ICVLV,ITYPE,TTL(15),VNAM(10),PNAM(2),NLVL(2),NENG(2,12),
                 1LEVEL(2,12),NRA,NCA,NRB,NCB,JAL(8),NI,NZ,NVBL,NEACT,NG12,MULT,
                 2NSUBJ,NLUV ,NW1,NW2,NT,ISEC,NPZ,NJZ,NOUNF,NG1AG,IREC1,IREC2,IREC3
                 3,NTRAN(10),INAM(10),LUV(15),MXLUV(15)
0003              DOUBLE PRECISION DSQV,DSQU,DSSCP,D
0004              DIMENSION SUB(12,12),RE(12),CE(12),C(12),CB(12),AA1(12,12),RE1(12)
                 1,RE2(12),CE1(12),CE2(12),CA1(12),QA2(12),QB1(12),QB2(12),SUB1(12,1
                 22),SUB2(12,12),F(55),E(55),CRAP(11),EI(55),HA(55),HB(55),HAB(55),
                 3HSB(55),HH(55),DSSCP(15,15),CUMC(15)
0005              NI=NIZ
0006              NJ=NJZ
0007         4000 BACKSPACE NW2
0008              READ(NW2)AA1
0009              REWIND NW2
0010              READ(NW2) DSSCP
0011              DO 101 IX=1,3
0012          101 READ(NW2) SUB,SUB,SUB,SUB,SUB,SUB,SUB,SUB,SUB,SUB
0013              READ(NW2) CUMC,CUMC
0014              KG = NVBL
0015              DO 3011 NV1=1,KC
0016              DO 299 ITX=1,NV1
0017          299 READ (NW2) NI,NJ,K,SUB,RE,CE,C,CB
0018              BACKSPACE NW2
0019              DO 302 JG = 1,12
0020              RE1(JG)=RE(JG)
0021              CE1(JG) = CE(JG)
0022              CA1(JG) = C(JG)
0023              CB1(JG) = CB(JG)
0024              DO 302 JH=1,12
0025         302  SUB1(JG,JH) = SUB(JG,JH)
0026              DO 301 NV2 = NV1,KG
0027              READ (NW2) NI,NJ,K,SUB,RE,CE,C,CB
0028              DO 303 JG = 1,12
0029              RE2(JG) = RE(JG)
0030              CE2(JG) = CE(JG)
0031              CA2(JG) = C(JG)
0032              QB2(JG) = CB(JG)
0033              DO 303 JH = 1,12
0034         303  SUB2(JG,JH) = SUB(JG,JH)
0035              D = DSSCP(NV1,NV2)
0036              CALL GENRE(D,AA1,SUB1,SUB2,RE1,RE2,CE1,CE2,QA1,QA2,QB1,QB2,NV1,
                 1NV2,NI,NJ,E,FA,HH,HAB,HSB,NBESS,NJE2)
0037         301  CONTINUE
0038              REWIND NW2
0039              READ(NW2)CUMC,CUMC,CUMC,CUMC,CUMC,CUMC,CUMC,CUMC,CUMC,CUMC,CUMC,
                 1CUMC,CUMC,CUMC,CUMC,CUMC,CUMC,CUMC,CUMC,CUMC
0040              DO 108  I7=1,3
0041          108 READ(NW2) SUB,SUB,SUB,SUB,SUB,SUB,SUB,SUB,SUB,SUB
0042              READ(NW2) CUMC,CUMC
0043         3011 CONTINUE
0044              NRA = NVBL
0045              NCA = NVBL
0046              NRB = NVBL
0047              NCB=NVBL
0048              CALL INSLCE(E,FI,CRAP)
```

```
0049              ALDE = CRAP(NRA)
0050              NSTEP=1
0051              IREC=IREC1-1
0052              IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0053         501  WRITE(N1'IREC1,2005)(TTL(IJ),IJ=1,15)
0054              WRITE(N2'IREC2,2006)
0055              NSTEP=2
0056              IREC=IREC1-1
0057              IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0058         502  WRITE(N1'IREC1,2003)
0059              WRITE(N2'IREC2,2003)
0060              NSTEP=3
0061              IREC=IREC1-1
0062              IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0063         503  WRITE(N1'IREC1,2007)
0064              WRITE(N2'IREC2,2008)FNAM(NI),FNAM(NJ)
0065              CALL WRIR(E,NRA,1)
0066              NSTEP=4
0067              IREC=IREC1-1
0068              IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0069         504  WRITE(N1'IREC1,2003)
0070              WRITE(N2'IREC2,2003)
0071              NSTEP=5
0072              IREC=IREC1-1
0073              IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0074         505  WRITE(N1'IREC1,2009)
0075              WRITE(N2'IREC2,2003)
0076              CALL WRIR(CRAP,NRA,0)
0077              DO 312 I=1,NRA
0078              II = LTERM(I,I)
0079              IF(E(II)) 321,321,325
0080         325  CRAP(I) = SQRT(E(II))
0081         312  CONTINUE
0082              DO 313 I = 1,NRA
0083              DO 313 J=I,NRA
0084              IJ = LTERM(I,J)
0085         313  RR(IJ) = E(IJ)/(CRAP(I)*CRAP(J))
0086              NSTEP=6
0087              IREC=IREC1-1
0088              IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0089         506  WRITE(N1'IREC1,2003)
0090              WRITE(N2'IREC2,2003)
0091              NSTEP=7
0092              IREC=IREC1-1
0093              IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0094         507  WRITE(N1'IREC1,2010)
0095              WRITE(N2'IREC2,2003)
0096              CALL WRIR(RR,NRA,1)
0097         321  CONTINUE
0098              NSTEP=8
0099              IREC=IREC1-1
0100              IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0101         508  WRITE(N1'IREC1,2003)
0102              WRITE(N2'IREC2,2003)
0103              NSTEP=9
0104              IREC=IREC1-1
```

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FORTRAN IV G LEVEL  19                MAINB           DATE = 71253        13/24/17

0105                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0106          509   WRITE(N1'IREC1,2011)FNAM(NI)
0107                WRITE(N2'IREC2,2012)FNAM(NJ)
0108                REWIND NW2
0109                WRITE(NW2) HAB,HA,HB,E,CRAP,EE,HSB,NDFE,NDFI,ALDE,NI,NJ,NDFSB
0110                REWIND NW2
0111                RETURN
0112          1001  WRITE(N1'IREC1,2001)KOUNT
0113                WRITE(N2'IREC2,2002)KOUNT
0114                KOUNT=KOUNT+1
0115                GO TO(501,502,503,504,505,506,507,508,509),NSTEP
0116          2001  FORMAT(55X,'PAGE',I4,'L',16X/)
0117          2002  FORMAT(55X,'PAGE',I4,'R',16X/)
0118          2003  FORMAT(80X)
0119          2005  FORMAT(15A4,'  MULTIVARIA',8X)
0120          2006  FORMAT('TE ANALYSIS',69X)
0121          2007  FORMAT(40X,'MATRIX E AFTER ELIMINATION OF FA',8X)
0122          2008  FORMAT('CTORS(',A4,') AND (',A4,')',58X)
0123          2009  FORMAT(40X,'STEPWISE LOG DETERMINANTS',15X)
0124          2010  FORMAT(40X,'CORRELATIONS BASED ON E',17X)
0125          2011  FORMAT(40X,'SUBTOTALS (ALL EFFECTS) ',A4,' AND',8X)
0126          2012  FORMAT(A4,76X)
0127                END
```

```
FORTRAN IV G LEVEL 19                GENME          DATE = 71253          13/24/17

0001          SUBROUTINE GENME(D,NN1,SUB1,SUB2,RE1,RE2,CE1,CE2,QA1,QA2,QB1,QB2,
             1NV1,NV2,NI,NJ,E,HA,HB,HAB,HSB,NDFSB,NDFE)
              C
              C     GENERATES THE ELEMENTS OF SUM OF SQUARES AND PRODUCTS
              C     MATRICES FOR ERROR (E) AND EFFECTS OR HYPOTHESES (H)
              C
0002          DOUBLE PRECISION SSUB,SPR,S,T,DN,ET,D
0003          COMMON N,ICVLV,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
             1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NG12,MULT,
             2NSUBJ,NLUV ,NW1,NW2,NT,ISEQ,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IRLC3
             3,N(RAN(10),TRAN(10),LUV(10),MNLUV(10)
0004          DIMENSION  SUB1(12,12),SUB2(12,12),RE1(1),RE2(1),CE1(1),CE2(1),
             1     QA1(1),QA2(1),QB1(1),CB2(1),E(1),HA(1),HB(1),HAB(1),HSB(1),
             2     R(12),RB(12),NN1(12,12),NIDOT(12)
0005          NG = 0
0006          SSUB = 0.DO
0007          SUMA=0.
0008          SUMB=0.
0009          NR = NLVL(NI)
0010          NC = NLVL(NJ)
0011          NDFSB = -1
0012          SPR = 0.DO
0013          DO 1 I = 1,NR
0014          DO 1 J = 1,NC
0015          S = 0.DO
0016          T = 0.DO
0017          S = SUB1(I,J)
0018          T = SUB2(I,J)
0019          DN = 0.DO
0020          DN=NN1(I,J)
0021          IF(NN1(I,J))1,1,2
0022       2  SUMA = SUMA +SUB1(I,J)
0023          SUMB = SUMB + SUB2(I,J)
0024          NG=NG+NN1(I,J)
0025          SPR=SPR+S*T/DN
0026          NDFSB = NDFSB + 1
0027       1  CONTINUE
0028          ET = 0.DO
0029          ET=D-SPR
0030          S = 0.DO
0031          DN = 0.DO
0032          S = SUMA
0033          T = 0.DO
0034          T = SUMB
0035          DN = NG
0036          SSUB=SPR-S*T/DN
0037          DO 6 I = 1,NR
0038          NIDOT(I) = 0
0039          R(I) = 0.
0040          RB(I) = 0.
0041          DO 6 J = 1,NC
0042          NIDOT(I)=NIDOT(I)+NN1(I,J)
0043          R(I) = R(I) + SUB1(I,J)
0044       6  RB(I) = RB(I) + SUB2(I,J)
0045          SRB = 0.
0046          DO 7 I = 1,NR
```

```
FORTRAN IV G LEVEL  19                  GENHE               DATE = 71253          13/24/17

0047                    AN = NIDOT(I)
0048            7       SRU = SRU + RE1(I)*RB(I)/AN
0049                    SRA = 0.
0050                    DO 8 I = 1,NR
0051            8       SRA = SRA + RE1(I)*QA2(I)
0052                    SCA = 0.
0053                    DO 9 J = 1,NC
0054            9       SCA = SCA + CE1(J) * QB2(J)
0055                    SINT = SPR - SPU - SCA
0056                    IJ = LTERM(NV1,NV2)
0057                    E(IJ) = ET
0058                    HA(IJ) = SRA
0059                    HB(IJ) = SCA
0060                    HAB(IJ) = SINT
0061                    HSB(IJ) = SSUB
0062                    NDFE = NG - NDFSB - 1
0063                    RETURN
0064                    END
```

```
FORTRAN IV G LEVEL 19                MAINE          DATE = 71253        13/24/17

0001            SUBROUTINE MAINE
0002            COMMON N,IOVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
               1LEVEL(2,12),NR#,NCA,NRB,NCB,JA8(8),NI,N2,NVBL,AFACT,NG12,MULT,
               2NSUBJ,NLUV ,NW1,NW2,NT,ISEQ,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC3
               3,NTRAN(10),TNAM(10),LUV(10),NNLUV(10)
0003            DIMENSION HAB(55),HA(55),HB(55),CRAP(11),EI(55),E(55),HSB(55)
0004            READ(NW2)  HAB,HA,HB,E,CRAP,EI,HSB,NDFE,NDFI,ALDE,NI,NJ,NDFSB
0005            REWIND NW2
0006            CALL TENAT(HSB,E,CRAP,EI,NDFE,NDFSB,ALDE,NI,NJ)
0007            NDFI = NDFSB - NLVL(NI) - NLVL(NJ) + 2
0008            IF(NDFI) 501,501,502
0009         502  NSTEP=1
0010            IREC=IREC1+1
0011            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0012         50   WRITE(N1'IREC1,2003)
0013            WRITE(N2'IREC2,2003)
0014            NSTEP=2
0015            IREC=IREC1-1
0016            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0017         51   WRITE(N1'IREC1,25)FNAM(NI),FNAM(NJ)
0018            WRITE(N2'IREC2,2003)
0019            CALL TENAT(HAB,E,CRAP,EI,NDFE,NDFI,ALDE,NI,NJ)
0020         501  NDFI = NLVL(NI) - 1
0021            IF(NDFI) 503,503,504
0022         504  NSTEP=3
0023            IREC=IREC1-1
0024            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0025         52   WRITE(N1'IREC1,2003)
0026            WRITE(N2'IREC2,2003)
0027            NSTEP=4
0028            IREC=IREC1-1
0029            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0030         53   WRITE(N1'IREC1,27)FNAM(NI)
0031            WRITE(N2'IREC2,2003)
0032            CALL TENAT(HA,E,CRAP,EI,NDFE,NDFI,ALDE,NI,NJ)
0033         503  NDFI = NLVL(NJ) - 1
0034            IF(NDFI) 505,505,506
0035          506 NSTEP=5
0036            IREC=IREC1-1
0037            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0038         54   WRITE(N1'IREC1,2003)
0039            WRITE(N2'IREC2,2003)
0040            NSTEP=6
0041            IREC=IREC1-1
0042            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0043         55   WRITE(N1'IREC1,27)FNAM(NJ)
0044            WRITE(N2'IREC2,2003)
0045            CALL TENAT(HB,E,CRAP,EI,NDFE,NDFI,ALDE,NI,NJ)
0046         505  ISEQ = 17
0047            WRITE(NW2) NSUBJ
0048            REWIND NW2
0049            NSTEP=7
0050          605 IREC=IREC1-1
0051            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0052            WRITE(N1'IREC1,2003)
0053            WRITE(N2'IREC2,2003)
```

```
FORTRAN IV G LEVEL 19                MAINE           DATE = 71253        13/24/17

0054                GO TO 605
0055             56 KKOUN=KOUNT-2
0056                WRITE(N1'IREC1,2004)KKOUN'
0057                WRITE(N1'IREC1,2003)
0058                WRITE(N1'IREC1,2005)
0059                WRITE(N1'IREC1,2006)
0060                WRITE(N1'IREC1,2007)
0061                CO 601 IJ=1,38
0062            601 WRITE(N1'IREC1,2003)
0063                CO 602 IJ=1,43
0064            602 WRITE(N2'IREC2,2003)
0065                ITEMP=NVBL
0066                NVBL=NLUV
0067                NLUV=ITEMP
0068                RETURN
0069           1001 WRITE(N1'IREC1,2001)KOUNT
0070                WRITE(N2'IREC2,2002)KOUNT
0071                KOUNT=KOUNT+1
0072                GO TO (50,51,52,53,54,55,56),NSTEP
0073           2001 FORMAT(55X,'PAGE',I4,'L',16X/)
0074           2002 FORMAT(55X,'PAGE',I4,'R',16X/)
0075           2003 FORMAT(60X)
0076           25   FORMAT(40X,'INTERACTION ',A4,' * ',A4,17X)
0077           27   FORMAT(49X,A4,' EFFECTS',19X)
0078           2004 FORMAT('PAGE',I3,' WAS THE LAST PAGE OF YOUR MULTIVARIATE RESULTS.
                    1',25X)
0079           2005 FORMAT( 'YOU NOW HAVE THE FOLLOWING OPTIONS:',45X)
0080           2006 FORMAT('PRESS   KEY  4 TO PREFORM ANOTHER MULTIVARIATE ANALYSIS',
                    125X)
0081           2007 FORMAT('        KEY 31 TO TERMINATE',53X)
0082                END
```

```
FORTRAN IV G LEVEL 19          TEMAT          DATE = 71253          13/24/17

0001          SUBROUTINE TEMAT(H,E,CRAP,EI,NDFE,NDFH,ALDE,NI,NJ)
              C
              C     CONTROLS THE MULTIVARIATE ANALYSIS (LILELIHOOD-RATIO,
              C     UNION-INTERSECTION, AND DISCRIMINANT ANALYSIS)
              C
0002          COMMON N,IGVLV,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
             1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,AFACT,NG12,MULT,
             2NSUBJ,NLUV ,NN1,NN2,NT,ISEQ,NI2,NJ2,KOUNT,NDIAG,IREC1,IREC2,IREC3
             3,NTRAN(10),TNAM(10),LUV(10),XNLUV(10)
0003          DIMENSION H(1),E(1),CRAP(1),EI(1),T(100),U(10,10),SYM(55),PE(30),
             1HX(55),DIS(30),ROIS(30)
0004          NRA = .VBL
0005          NCA = NDFH
0006          NRB = NRA
0007          NCB = NRA
0008          NRD = NLVL(NI)
0009          NCGL = NLVL(NJ)
0010          IFG=1
0011          B = FNAM(NJ)
0012          IHX = (NRA*(NRA+1))/2
0013          DO 44 I = 1,IHX
0014          I = I
0015          IF (H(I))43,44,43
0016     44   CONTINUE
0017          GO TO 45
0018     43   CALL TRI(H,T,CRAP)
0019          IF(NCB-1)40,40,41
0020     41   NCT = NCB
0021          NCB = NRA
0022          DO 1 I=1,IHX
0023     1    H(I) = H(I)+E(I)
0024          CALL INSLD(H,IHX,CRAP)
0025          ALDH = CRAP(NRA)
0026          AM = .NDFE
0027          AM = AM   + 0.5*FLOAT (NDFH-NVBL-1)
0028          DF = NDFH*NRA
0029          XST = -(ALDE-ALDH)*AM
0030          IFG=1
0031          NSTEP=1
0032          IREC=IREC-1
0033          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0034     3001 WRITE(N1'IREC1,2003)
0035          WRITE(N2'IREC2,2003)
0036          NSTEP=2
0037          IREC=IREC1-1
0038          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0039     3002 WRITE(N1'IREC1,2010)XST
0040          WRITE(N2'IREC2,2011)DF
0041          PR = CHIX(XST,DF)
0042          FCX = (FLOAT (NDFH))**2 + FLOAT (NRA**2) - 5.
0043          DEL = DF*FCX
0044          DEL = DLL/(48.*AM**2)
0045          DG = DF + 4.
0046          PS = CHIX(XST,DG)
0047          PZ = PR +(PS-PR)*DEL
0048          IF(PZ - 1.0) 310,310,311
```

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```
0049          310  PR = PZ
0050          311  IF(PR - 1.0) 312,313,313
0051          313  PR = 1.0
0052          312  PR = 1.-PR
0053               NSTEP=3
0054               IREC=IREC1-1
0055               IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0056          3003 WRITE(N1'IREC1,2012)PR
0057               WRITE(N2'IREC2,2003)
0058               NSTEP=4
0059               IREC=IREC1-1
0060               IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0061          3004 WRITE(N1'IREC1,2003)
0062               WRITE(N2'IREC2,2003)
0063               NSTEP=5
0064               IREC=IREC1-1
0065               IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0066          3005 WRITE(N1'IREC1,2013)
0067               WRITE(N2'IREC2,2003)
0068               CALL WRIR(H,NRA,1)
0069           212 DO 161 I=1,NVBL
0070               II = LTERM(I,I)
0071               IF(H(II)) 171,171,315
0072          315  DIS(I) = SQRT(H(II))
0073          161  CONTINUE
0074               DO 162 I=1,NVBL
0075               DO 162 J=1,NVBL
0076               IJ = LTERM(I,J)
0077          162  SYM(IJ) = H(IJ)/(DIS(I)*DIS(J))
0078               NSTEP=6
0079               IREC=IREC1-1
0080               IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0081          3006 WRITE(N1'IREC1,2003)
0082               WRITE(N2'IREC2,2003)
0083               NSTEP=7
0084               IREC=IREC1-1
0085               IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0086          3007 WRITE(N1'IREC1,2014)
0087               WRITE(N2'IREC2,2003)
0088               CALL WRIR(SYM,NVBL,1)
0089          171  CONTINUE
0090               GO TO (213,95),IFG
0091           213 DO 3 J = 1,NCT
0092               DO 3 I = 1,NRA
0093               U(I,J) = 0.
0094               DO 3 K = 1,NRA
0095               IK = LTERM(I,K)
0096               KJ = (J-1)*NRA + K
0097           3   U(I,J) = U(I,J) + HX(IK)*T(KJ)
0098               DO 4 J = 1,NCT
0099               DO 4 I = 1,J
0100               IJ = LTERM(I,J)
0101               SYM(IJ) = 0.
0102               DO 4 K=1,NRA
0103               KI = (I-1)*NRA + K
0104           4   SYM(IJ) = SYM(IJ) + T(KI)*U(K,J)
```

```
FORTRAN IV G LEVEL  19                  TEMAT          DATE = 71253          13/24/17

0105                DO 65 J=1,NCT
0106                DO 60 I=1,J
0107                KJ = LTERM(I,J)
0108                HX(IJ) = 0.
0109                DO 60 K=1,NCT
0110                IK = LTERM(I,K)
0111                KJ = LTERM(K,J)
0112          60    HX(IJ) = HX(IJ)+SYM(IK)*SYM(KJ)
0113                CALL FACE(HX,PE,NCT)
0114                RCAN = 0.
0115                DO 10 I = 1,NCT
0116          10    RCAN = RCAN + PE(I)**2
0117                DO 11 I = 1,NCT
0118          11    PE(I) = PE(I)/SQRT (RCAN)
0119                RCAN = SQRT(RCAN)
0120                IF(NRA-NDFH)12,13,13
0121          12    NS = NRA
0122                GO TO 14
0123          13    NS = NDFH
0124          14    AM = NDFH - NRA
0125                AM = (ABS (AM)-1.)/2.
0126                AN = NDFE-NRA-1
0127                AN = AN/2.
0128                NSTEP=8
0129                IREC=IREC1-1
0130                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0131          3008  WRITE(N1'IREC1,2003)
0132                WRITE(N2'IREC2,2003)
0133                NSTEP=9
0134                IREC=IREC1-1
0135                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0136          3009  WRITE(N1'IREC1,2015)
0137                WRITE(N2'IREC2,2016)RCAN
0138                NSTEP=10
0139                IREC=IREC1-1
0140                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0141          3010  WRITE(N1'IREC1,2017)NS,AM,AN
0142                WRITE(N2'IREC2,2003)
0143                DO 16 I = 1,NRA
0144                DIS(I) = 0.
0145                DO 16 J = 1,NCT
0146          16    DIS(I) = DIS(I) + U(I,J)*PE(J)
0147          52    NSTEP=11
0148                IREC=IREC1-1
0149                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0150          3011  WRITE(N1'IREC1,2003)
0151                WRITE(N2'IREC2,2003)
0152                NSTEP=12
0153                IREC=IREC1-1
0154                IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0155          3012  WRITE(N1'IREC1,2018)
0156                WRITE(N2'IREC2,2003)
0157                CALL WRIR(DIS,NRA,0)
0158                DO 18 I = 1,NRA
0159                RDIS(I) = 0.
0160                DO 18 J = 1,NRA
```

```
0161            IJ = LTERM(I,J)
0162         18 RDIS(I) = E(IJ)*DIS(J)+RDIS(I)
0163            CON = 0.
0164            DO 19 J = 1,NRA
0165          19 CON = CON + RDIS(J)*DIS(J)
0166            DO 20 I = 1,NRA
0167            II = LTERM(I,I)
0168         20 RDIS(I) = RDIS(I)/SQRT (CON*E(II))
0169            NSTEP=13
0170            IREC=IREC1-1
0171            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0172         3013 WRITE(N1'IREC1,2003)
0173            WRITE(N2'IREC2,2003)
0174            NSTEP=14
0175            IREC=IREC1-1
0176            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0177         3014 WRITE(N1'IREC1,2019)
0178            WRITE(N2'IREC2,2003)
0179            CALL WRIR(RDIS,NRA,0)
0180            GO TO 99
0181         45 NSTEP=15
0182            IREC=IREC1-1
0183            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0184         3015 WRITE(N1'IREC1,2003)
0185            WRITE(N2'IREC2,2003)
0186            NSTEP=16
0187            IREC=IREC1-1
0188            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0189         3016 WRITE(N1'IREC1,2020)
0190            WRITE(N2'IREC2,2003)
0191            GO TO (99,210),IFG
0192            GO TO 99
0193         40 DO 50 I = 1,NRA
0194            DIS(I) = 0.
0195            DO 50 J = 1,NRA
0196            IJ = LTERM(I,J)
0197         50 DIS(I) = E(IJ)*T(J)+DIS(I)
0198            F = 0.
0199            DO 51 I = 1,NRA
0200          51 F = F+DIS(I)*T(I)
0201            DFN = NRA
0202            DFA = NDEL-NRA+1
0203            F = F*DFN/DFA
0204            IFG=2
0205            NSTEP=17
0206            IREC=IREC1-1
0207            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0208         3017 WRITE(N1'IREC1,2003)
0209            WRITE(N2'IREC2,2003)
0210            NSTEP=18
0211            IREC=IREC1-1
0212            IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0213         3018 WRITE(N1'IREC1,2021)   F,DFN,DFN
0214            WRITE(N2'IREC2,2003)
0215            GO TO 52
0216          210 DO 211 I=1,IMX
```

```
FORTRAN IV G LEVEL 19                TEMAT          DATE = 71253          13/24/17

0217          211 H(I)=H(I)+E(I)
0218              GO TO 212
0219          99  RETURN
0220          1001 WRITE(N1'IREC1,2001)KOUNT
0221               WRITE(N2'IREC2,2002)KOUNT
0222               KOUNT=KOUNT+1
0223               GO TO(3001,3002,3003,3004,3005,3006,3007,3008,3009,3010,3011,3012,
                  13013,3014,3015,3016,3017,3018),NSTEP
0224          2001 FORMAT(55X,'PAGE',I4,'L',16X/)
0225          2002 FORMAT(55X,'PAGE',I4,'R',16X/)
0226          2003 FORMAT(80X)
0227          2010 FORMAT('LIKELIHOOD RATIO TEST STATISTIC, CHI-SQUARE = ',E14.4,' WI
                  1TH',15X)
0228          2011 FORMAT(F10.0,' D.F.',65X)
0229          2012 FORMAT(30X,'SIGNIFICANT AT LEVEL ',E13.3,16X)
0230          2013 FORMAT(40X,'MATRIX H+E',30X)
0231          2014 FORMAT(40X,'CORRELATIONS BASED ON H+E',15X)
0232          2015 FORMAT('STANDARDIZED ROY STATISTIC OR SQUARE OF A CANONICAL CORREL
                  1ATION = ',13X)
0233          2016 FORMAT(E16.6,64X)
0234          2017 FORMAT(10X,'READ HECK CHARTS WITH S = ',I3,' M = ',F8.1,' N = ',F8
                  1.1,15X)
0235          2018 FORMAT(20X,'HEIGHT OF DISCRIMINANT FUNCTION',28X)
0236          2019 FORMAT(7X,'CORRELATIONS BETWEEN DISCRIMINANT FUNTION AND ORIGINAL
                  1VARIABLES',8X)
0237          2020 FORMAT(20X,'DEGENERATE CASE ALL H-ELEMENTS ZERO',24X)
0238          2021 FORMAT('TEST STATISTIC F = ',F10.4,' WITH ',F4.0,' AND ',F6.0,' D.
                  1F.',25X)
0239               END
```

```
FORTRAN IV G LEVEL 19          TRI          DATE = 71253          13/24/17

0001          SUBROUTINE TRI(A,T,D)
              C
              C       TRI ROUTINE . THE UPPER HALF OF A SYMMETRIC GRAMIAN MATRIX
              C       IS STORED AS A ONE DIMENSIONAL VECTOR IN PACKED FORM A(1,1),
              C       A(1,2),A(2,2),A(1,3),A(2,3),A(3,3), ETC. NRA AND NCA (FIRST
              C       TWO COMMONS) MUST BE SET EQUAL TO THE ORDER OF THE MATRIX.
              C       D IS A WORKING FIELD, AND SHOULD BE DIMENSIONED ONE LARGER
              C       THAN NRA AT THE END,  NRB=NRA, BUT NCB IS REPLACED BY THE
              C       RANK OF THE MATRIX A . THE MATRIX T , PACKED IN ORDER T(1,1),
              C       T(2,1),T(3,1),....,T(NRA,1),T(1,2),....,T(NRA,2),....,T(NRA,NRB),
              C       IS A TRIANGULAR MATRIX T SUCH THAT T*T' = A . IF THE CALLING
              C       PROGRAM WISHES TO USE T AS A DOUBLE SUBSCRIPTED FIELD, THE
              C       DIMENSION OF THE FIRST ARGUMENT MUST E Q U A L NRA . IF THIS
              C       IS INCONVENIENT, SINGLE-DIMENSION T IN THE SAME WAY AS A, THEN
              C       UNPACK T INTO A DOUBLE SUBSCRIPTED TU BY CALCULATING IJ =
              C       (J-1)*NRA + I . THEN TU(I,J) = T(IJ)
              C
0002          COMMON N,IOVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
             1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NG12,MULT.
             2NSUBJ,NLUV ,NW1,NW2,NT,ISEC,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC3
             3,NRAN(10),TNAM(10),LUV(10),MNLUV(10)
0003          DIMENSION   A(1),T(1),D(1)
0004          NRB = NRA
0005          NCB = NRA
0006          DO 577 I=1,NRA
0007          I = I
0008          CALL SLITO(0)
0009          DO 577 J=I,NRA
0010          J=J
0011          IJA = (J*(J-1))/2 + I
0012          SUM = A(IJA)
0013          IM = I-1
0014     400  IF(IM) 566,566,575
0015     575  DO 574 K=1,IM
0016          K=K
0017          KIA = (K-1)*NRB + I
0018          KJA = KIA + J - I
0019     574  SUM = SUM - T(KIA)*T(KJA)
0020     566  IF(J-I) 585,585,573
0021     585  IF(A(IJA)) 572,572,576
0022     576  D(I) = SUM
0023          QQ = A(IJA)
0024     401  IF(SUM/QQ + 5.E-4) 572,570,570
0025     570  IF(SUM/QQ - 5.E-5) 590,590,661
0026      661 IF(I-NCA) 573,573,590
0027     572  WRITE(N1'IREC1,650)
0028          WRITE(N2'IREC2,2003)
0029     650  FORMAT(40X,'MATRIX IS NOT GRAMIAN',19X)
0030     2003 FORMAT(80X)
0031          GO TO 607
0032     590  CALL SLITO(1)
0033          D(I) = 0.
0034     573  IJ = (I-1)*NRB + J
0035          CALL SLITOT(1,JLL)
0036          IF(JLL) 569,569,591
0037     569  T(IJ) = SUM/SQRT (D(I))
```

FORTRAN IV G LEVEL 19 TRI DATE = 71253 13/24/17

```
0038                GO TO 577
0039          591   CALL SLITO(1)
0040          402   IF(ABS (SUM/CO) - 5.E-5) 592,592,662
0041           662  IF(I-NCA) 572,572,592
0042          592   T(IJ) = 0.
0043          577   CONTINUE
0044                IF(NRB-1) 601,601,630
0045          630   DO 600 I=2,NRB
0046                I=I
0047                DO 600 J=2,J
0048                J=J
0049                IJC = (I-1)*NRB + J - 1
0050          600   T(IJC)=0.
0051          601   CONTINUE
0052                DO 602 I=1,NCB
0053                I=I
0054                DO 603 J=1,NRB
0055                J=J
0056                IJD = (I-1)*NRB + J
0057                IF(T(IJD)) 602,604,602
0058          604   IF(J-NRB) 603,605,605
0059          603   CONTINUE
0060          605   NCB = NCB-1
0061          403   IF(I-NCB-1) 606,610,610
0062          606   DO 608 K=I,NCB
0063                DO 608 L=1,NRB
0064                IJE = K*NRB + L
0065                IJF = IJE - NRB
0066          608   T(IJF) = T(IJE)
0067                GO TO 601
0068          602   CONTINUE
0069          610   GO TO 607
0070          607   RETURN
0071                END
```

FORTRAN IV G LEVEL 19 CHIX DATE = 71253 13/24/17

```
0001                FUNCTION CHIX(X,DF)
                    C
                    C     CHI-SQUARE P FROM X
                    C
0002                CHIX=GAMX(X/2.,DF/2.)
0003                RETURN
0004                END
```

```
FORTRAN IV G LEVEL  19                  GAMX                DATE = 71253          13/24/17

0001                  FUNCTION GAMX(X,DE)
                C
                C     INCOMPLETE GAMMA DISTRIBUTION, FORWARD, P FROM X
                C
0002                  Y=X
0003                  DF=DE
0004                  SUM=0.
0005                  IF(DF-200.)20,21,21
0006             20   IF(X)1,1,2
0007              1   GAMX=0.
0008                  GO TO 99
0009              2   IF(DF)3,3,4
0010              3   GAMX = 1.
0011                  GO TO 99
0012              4   AI = DF
0013                  F = AI * ALOG(Y) -Y -ELGGM(AI+1.)
0014             16   IF(F+80.)10,10,11
0015             11   FG=EXP (F)
0016                  FH = FG
0017             12   SUM = SUM + FG
0018                  FG=FG*Y/(AI+1.)
0019                  AI = AI + 1.
0020                  IF(AI-200.)28,28,25
0021             28   IF(FG-FH)13,14,14
0022             14   IF(AI-200.)12,12,25
0023             13   FH = FG
0024                  IF(FG/SUM - 1.E-8)15,15,12
0025             10   AI = AI+1.
0026                  IF(AI-200.)27,27,25
0027             27   F=F+ALOG(Y/AI)
0028                  GO TO 16
0029             21   DH=9.*DF
0030             26   YN = ((Y/DF)**0.33333333-1.+1./DH)*SQRT (DH)
0031                  UNMIX=YORHX(YN)
0032                  GAMX=UNMIX+SUM
0033                  GO TO 99
0034             15   GAMX = SUM
0035                  GO TO 99
0036             25   DH = 9.*AI
0037                  CF = AI
0038                  GO TO 26
0039             99   RETURN
0040                  END
```

```
FORTRAN IV G LEVEL  19                  YORMX                   DATE = 71253          13/24/17

0001                  FUNCTION YORMX(X)
                      C
                      C       NORMAL DISTRIBUTION, ARGUMENT X, RESULT P
                      C
0002                  Y=X
0003                  IF(X+13.)1,1,2
0004                1 YORMX=0
0005                  GO TO 99
0006                2 IF(X-7.)3,3,4
0007                4 YORMX = 1.
0008                  GO TO 99
0009                3 G=1.12837917*EXP (-Y*Y/2.)
0010                  Z=G/2.82842712
0011                  XA = ABS (Y)
0012                  IF(XA-2.5)5,6,6
0013                6 U = 1./(XA+1./(XA+2./(XA+3./(XA+4./(XA+5./(XA+6./(XA+7./(XA+8./(XA
                     1+9./(XA+10./(XA+11./(XA+12./XA))))))))))))
0014               10 IF(Y)7,8,8
0015                7 YORMX = U*Z
0016                  GO TO 99
0017                8 YORMX=1.-U*Z
0018                  GO TO 99
0019                5 ET = 1.41421356/(1.41421356+0.3275911*XA )
0020                  U = G*((((0.94064607*ET-1.28782245)*ET+1.25969513)*ET-0.25212
                     18661*ET+0.225836846)*ET + 0.5
0021                  Z=1.
0022                  GO TO 10
0023               99 RETURN
0024                  END
```

```
FORTRAN IV G LEVEL 19          ELGGM          DATE = 71253          13/24/17

0001            FUNCTION ELGGM(X)
                C
                C       LOG OF GAMMA FUNCTION FOR ARGUMENTS GREATER THAN ZERO
                C
0002            Y=X
0003            TERM=1.0
0004            IF(X)1,1,2
0005          1 ELGGM = 0.
0006            GO TO 99
0007          2 IF(Y-10.)3,3,4
0008          3  TERM=TERM*Y
0009            Y=Y+1.
0010            GO TO 2
0011          4 ELGGM=(Y-0.5)*ALOG(Y)-Y+1./(12.*Y)-1./(360.*Y**3)+1./(1260.
               1*Y**5)-1./(1680.*Y**7)+0.91893853-ALOG(TERM)
0012         99 RETURN
0013            END
```

FORTRAN IV G LEVEL 19 FACE DATE = 71253 13/24/17

```
0001          SUBROUTINE FACE(R,FE,NRR)
              C
              C     OBTAINS THE LARGEST ROOT AND ASSOCIATED EIGENVECTOR OF
              C     A SYMETRIC MATRIX
              C
              C
              DIMENSION R(1275),F(50),FL(50),NTAG(50),FE(50),RTR(50)
0002          DOUBLE PRECISION OND,SUMA,SUMB,FJ,FEJ,RIJD,FEI
0003          NREF=0
0004          ITEC = 600/NRR
0005          ITR=0
0006       80 DO 99 I=1,NRR
0007       99 NTAG(I)=0
0008          NCOU=0
0009           DO 100 J=1,NRR
0010          F(J)=0.0
0011           DO 101 I=1,NRR
0012          IJA=LTERM(I,J)
0013          IF(I-J)105,101,105
0014      105 F(J)=F(J) + R(IJA)
0015      101 CONTINUE
0016      100 F(J)= -F(J)/2.0
0017      109 DO 110 I=1,NRR
0018          IF(NTAG(I)) 111,112,111
0019      111 FL(I)=-F(I)
0020           GO TO 110
0021      112 FL(I)=F(I)
0022      110 CONTINUE
0023          DO 120 I=1,NRR
0024           IF(FL(I))120,120,121
0025      120 CONTINUE
0026          GO TO 199
0027      121 IF(NCOU-2*NRR)122,122,199
0028      122 JA=1
0029          DO 123 J=2,NRR
0030           IF(FL(I)-FL(J))124,123,123
0031      124 FL(I)=FL(J)
0032          JA=J
0033      123 CONTINUE
0034          IF(NTAG(JA))125,126,125
0035      126 NTAG(JA)=1
0036           GO TO 130
0037      125 NTAG(JA)=0
0038      130 NCOU=NCOU+1
0039           DO 131 I=1,NRR
0040           IF(I-JA)132,131,132
0041      132 IJR=LTERM(I,JA)
0042          F(I)=F(I)+R(IJR)
0043      131 CONTINUE
0044           GO TO 109
0045      199 DO 200 I=1,NRR
0046      200 F(I)=-2.*F(I)
0047          DO 211 I=1,NRR
0048          II = LTERM(I,I)
0049      211 FE(I) = F(I) + SIGN (R(II),F(I))
0050          SUM=0.0
0051          DO 222 J=1,NRR
0052       222 SUM=SUM+ABS (FE(J))
```

FORTRAN IV G LEVEL 19 FACE DATE = 71253 13/24/17

```
0053          DO 223 K=1,NRR
0054      223 FE(K)=FE(K)/SQRT(SUM)
0055          NITE=0.
0056          ONC = 1.00
0057      303 DO 304 I=1,NRR
0058          SUMA=0.000
0059          SUMB=0.000
0060          DO 305 J=1,NRR
0061      306  FJ=0.000
0062          FJ = FE(J)
0063           FEJ=0.000
0064          FEJ=FE(J)
0065          IJD=LTERM(I,J)
0066          RIJD=0.000
0067          RIJD=R(IJD)
0068          SUMA=SUMA+RIJD*FJ
0069          SUMB=SUMB+FEJ*FJ
0070      305 CONTINUE
0071          FL(I)=FE(I)
0072          FEI=0.000
0073          FEI=SUMA/SUMB
0074      304 FE(I)=FEI
0075          NITE=NITE+1
0076          IF(NITE - ITEC) 320,320,399
0077      320 DO 321 I=1,NRR
0078          IF(ABS (FE(I)-FL(I))-1.E-6)321,321,303
0079      321 CONTINUE
0080      399 RETURN
0081          END
```

```
FORTRAN IV G LEVEL  19                  WRIR                DATE = 71253        13/24/17

0001          SUBROUTINE WRIR(R,NV,NN)
              C
              C  SUBROUTINE FOR WRITING CORRELATIONS, MEANS, AND FACTOR LOADINGS
              C   NN IS ZERO FOR FACTOR LOADINGS AND MEANS, ONE OTHERWISE
              C
0002          COMMON N,IOVLY,ITYPE,TTL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
             1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NG12,MULT,
             2NSUBJ,NLUV ,NW1,NW2,NT,ISEQ,NIZ,NJZ,KOUNT,NDIAG,IREC1,IREC2,IREC3
             3,NTRAN(10),TNAM(10),LUV(10),MNLUV(10)
0003          DIMENSION R(1275),JWR(7),RWR(7),UWR(7)
0004          DO 1101 I=1,NV
0005          NRE=(NV-1)/7+1
0006          DO 1102 J=1,NRE
0007          IF(7*J-NV) 1103,1103,1104
0008     1103 K=7
0009          GO TO 1105
0010     1104 K=7-7*J+NV
0011     1105 DO 1107 L=1,K
0012          JWR(L)=7*(J-1)+L
0013          JWRL = JWR(L)
0014     1107 UWR(L)=TNAM(JWRL)
0015          NSTEP=1
0016          IREC=IREC1-1
0017          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0018     401  WRITE(N1'IREC1,2003)
0019          WRITE(N2'IREC2,2003)
0020          NSTEP=2
0021          IREC=IREC1-1
0022          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0023     402  IF(K.LE.5)GO TO 301
0024          IF(K.GT.5)GO TO 302
0025     301  WRITE(N1'IREC1,501)(UWR(M),M=1,K)
0026          WRITE(N2'IREC2,2003)
0027          GO TO 303
0028     302  WRITE(N1'IREC1,501)(UWR(M),M=1,5)
0029          WRITE(N2'IREC2,502)(UWR(M),M=6,K)
0030     303  CONTINUE
0031          IF(NN)1129,1130,1129
0032     1130 DO 1131 M=1,K
0033          MF = JWR(M)
0034     1131 RWR(M) = R(MF)
0035          NSTEP=3
0036          IREC=IREC1-1
0037          IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0038     403  IF(K.LE.5)GO TO 304
0039          IF(K.GT.5)GO TO 305
0040     304  WRITE(N1'IREC1,503)(RWR(N),N=1,K)
0041          WRITE(N2'IREC2,2003)
0042          GO TO 306
0043     305  WRITE(N1'IREC1,503)(RWR(N),N=1,5)
0044          WRITE(N2'IREC2,504)(RWR(N),N=6,K)
0045     306  CONTINUE
0046           GO TO 1102
0047     1129 DO 1120 M=1,K
0048          MR= LTERM(I,JWR(M))
0049     1120 RWR(M)=R(MR)
```

```
FORTRAN IV G LEVEL  19                  WRIR                    DATE = 71253          13/24/17

0050                    VX=TNAM(I)
0051                    NSTEP=4
0052                    IREC=IREC1-1
0053                    IF(MOD(IREC,45) .EQ. 0) GO TO 1001
0054                404 IF(K.LE.5)GO TC 307
0055                    IF(K.GT.5)GO TO 308
0056                307 WRITE(N1'IREC1,505)VX,(RWR(N),N=1,K)
0057                    WRITE(N2'IREC2,2003)
0058                    GO TO 309
0059                308 WRITE(N1'IREC1,505)VX,(RWR(N),N=1,5)
0060                    WRITE(N2'IREC2,504)(RWR(N),N=6,K)
0061                309 CONTINUE
0062                1102 CONTINUE
0063                    IF(NN)1127,1128,1127
0064                1127 CONTINUE
0065                1101 CONTINUE
0066                1129 RETURN
0067                1001 WRITE(N1'IREC1,2001)KCUNT
0068                    WRITE(N2'IREC2,2002)KCUNT
0069                    KOUNT=KOUNT+1
0070                    GO TO(401,402,403,404),NSTEP
0071                2001 FORMAT(55X,'PAGE',I4,'L',16X/)
0072                2002 FORMAT(55X,'PAGE',I4,'R',16X/)
0073                2003 FORMAT(80X)
0074                501  FORMAT(12X,A4,4(0X,A4),16X)
0075                502  FORMAT(2(8X,A4),56X)
0076                 503 FORMAT(7X,1P5E12.4,13X)
0077                504  FORMAT(1P2E12.4,56X)
0078                505  FORMAT(3X,A4,1P5E12.4,13X)
0079                    END
```

```
FORTRAN IV G LEVEL 19                INSLD              DATE = 71253      13/24/17

0001          SUBROUTINE INSLD (A,T,D)
              C
              C     OBTAINS INVERSE OR CONDITIONAL INVERSE OF GRAMIAN
              C     MATRICES; ALSO OBTAINS STEP-WISE LOG-DETERMINANTS
              C
0002          COMMON N,IOVLY,ITYPE,ITL(15),VNAM(10),FNAM(2),NLVL(2),NEND(2,12),
             1LEVEL(2,12),ARA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NGIZ,MULT,
             2NSUBJ,NLUV ,NN1,NN2,NF,ISEQ,NIZ,NJZ,KCLNT,NDIAG,IREC1,IREC2,IREC3
             3,NTRAN(10),TNAM(10),LUV(10),MNLUV(10)
0003          DIMENSION A(1),T(1),D(1)
0004          CO = 0.
0005          DO 577 I=1,NRA
0006          CALL SLITO(0)
0007          DO 577 J=I,NRA
0008          IJA= ((J-1)*J)/2+ I
0009          SUM = A(IJA)
0010          IM= I-1
0011        400 IF(IM)566,566,575
0012        575 DO 574 K=1,IM
0013          KIA=(I*(I-1))/2 + K
0014          KJA = (J*(J-1))/2 + K
0015          IF(D(K)) 1584,574,1584
0016       1584 SUM=SUM-T(KIA)*T(KJA)/D(K)
0017        574 CONTINUE
0018        566 IF(J-I)585,585,573
0019        585 IF(A(IJA))576,1100,576
0020       1100 D(I)= SUM
0021          DO 1101 M=1,NRA
0022          MX= (M*(M+1))/2
0023          IF(A(MX))1102,1101,1102
0024       1102 CO= ABS (A(MX))
0025          GO TO 1103
0026       1101 CONTINUE
0027       1103 IF(QQ)572,1104,401
0028       1104 LLP= (NRA*(NRA+1))/2
0029          DO 1105 M=1,LLP
0030          IF(A(M))1106,1105,1106
0031       1106 CO=ABS (A(M))
0032          GO TO 1107
0033       1105 CONTINUE
0034       1107 IF(QQ)572,572,401
0035        576 D(I)=SUM
0036          CO=A(IJA)
0037        401 IF(ABS (SUM/CO)-5.E-5)590,590,573
0038        572 WRITE(N1'IREC1,1572)
0039          WRITE(N2'IREC2,2003)
0040       1572 FORMAT(17X,'MATRIX NOT POS DEFINITE OR POS SEMIDEFINITE',20X)
0041       2003 FORMAT(80X)
0042       1573 RETURN
0043        590 CALL SLITO(1)
0044          D(I)=0.0
0045        573 IJ= (J*(J-1))/2 + I
0046          CALL SLITOT(1,JLL)
0047          IF(JLL)569,569;591
0048        569 T(IJ)=SUM
0049          GO TO 577
```

```
FORTRAN IV G LEVEL  19                  INSLO                   DATE = 71253          13/24/1
0050          591 CALL SLITC(1)
0051          402 IF(ABS (SUM/G0)-5.E-51592,592,569
0052          592 T(IJ)=0.0
0053          577 CONTINUE
0054              DO 300 I=1,NRB
0055              IA=((I+1)*I)/2
0056              IF(T(IA))301,300,301
0057          301 T(IA)=1.0/T(IA)
0058          300 CONTINUE
0059              IF(NRB-1)701,701,702
0060          702 NM = NRB-1
0061              DO 303 I=1,NM
0062              IPX=I+1
0063              DO 303 J=IPX,NRA
0064              IIN=(J*(J+1))/2
0065              IAC=(J*(J-1))/2+I
0066              SUMI=0.0
0067              JMI=J-1
0068              DO 304 K=I,JMI
0069              IAB=(J*(J-1))/2+K
0070              IBC=(K*(K-1))/2+I
0071              IF(T(IIN))304,305,304
0072          304 SUMI=SUMI-T(IAB)*T(IBC)
0073              T(IAC)=SUMI*T(IIN)
0074              GO TO 303
0075          305 T(IAC)=0.0
0076          303 CONTINUE
0077              DO 101 I=1,NRA
0078              DO 101 J=I,NRA
0079              SUMX=0.0
0080              DO 901 K=J,NRA
0081               KIX=(K*(K-1))/2 +I
0082              KJX=KIX+ J- I
0083          901 SUMX=SUMX+T(KIX)*T(KJX)*C(K)
0084              JIX=(J*(J-1))/2+I
0085          101 T(JIX)=SUMX
0086          701  CONTINUE
0087              IF(D(1))114,114,115
0088          115 D(1)=ALOG(C(1))
0089              GO TO 118
0090          114 D(1)=0.-.99999999E38
0091          118 IF(NRA-1) 1573,1573,1575
0092         1575 DO 122 I=2,NRA
0093              IM=I-1
0094              IF(D(I))119,119,120
0095          120 IF(D(IM)+.99999999E+38)119,119,123
0096          123 D(I)=D(IM)+ALOG(C(I))
0097              GO TO 122
0098          119 D(I)=0.-.99999999E38
0099          122  CONTINUE
0100              RETURN
0101              END
```

FORTRAN IV G LEVEL 19 LTERM DATE = 71253 13/24/17

```
0001            FUNCTION LTERM(II,JJ)
                C
                C   LOCATES TERMS OF SYMMETRIC MATRICES STORED IN PACKED
                C   (UPPER TRIANGULAR) FORM
                C
0002                IF(II-JJ) 1,2,2
0003              1 LTERM = (JJ * (JJ-1))/2 + II
0004                GO TO 3
0005              2 LTERM = (II * (II-1))/2 + JJ
0006              3 RETURN
0007                END
```

```
FORTRAN IV G LEVEL 19          SLITO          DATE = 71253          13/24/17

0001          SUBROUTINE SLITO (IOS)
0002          COMMON N,IOVLY,ITYPE,TTL(15),VHAR(10),FNAR(2),NLVL(2),NEND(2,12),
             1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NG12,MULT,
             2NSUBJ,NDATA,NN1,NN2,NT,ISEC,NI2,NJ2,KOUNT,NDIAG,IREC1,IREC2,IREC3
             3,NTRAN(10)
0003          IF(IOS) 1,1,2
0004        2 JAB(IOS) = 1
0005          RETURN
0006        1 DO 3 K=1,8
0007        3 JAB(K) = 0
0008          RETURN
0009          END
```

```
FORTRAN IV G LEVEL  19                  SLITOT              DATE = 71253          13/24/17

0001                  SUBROUTINE SLITOT(IGO,JDO)
0002                  COMMON N,IOVLY,ITYPE,TTL(15),VNAM(10),ENAM(2),NLVL(2),NEND(2,12),
                     1LEVEL(2,12),NRA,NCA,NRB,NCB,JAB(8),N1,N2,NVBL,NFACT,NG12,MULT,
                     2ASUBJ,NDATA,NM1,NM2,NT,ISEC,NI2,NJ2,KOUNT,NDIAG,IREC1,IREC2,IREC
                     3,NTRAN(10)
0003                  IF(JAB(IGO)) 1,1,2
0004              1   JDO = 0
0005                  GO TO 3
0006              2   JDO = 1
0007              3   JAB(IGO) = 0
0008                  RETURN
0009                  END
```